The FOUNDRY

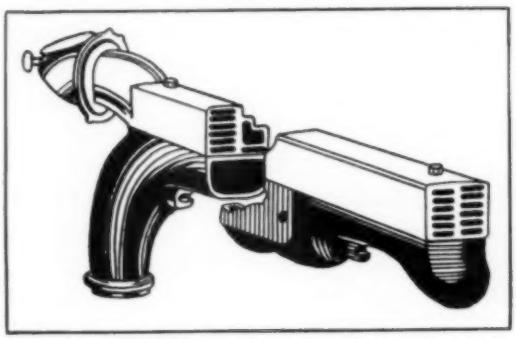
Volume 60
Number 3

Published
Semimonthly

CLEVELAND, OHIO, FEBRUARY 1, 1932

Castings Provide Comfort for Winter Driving

REMEMBER way back in the early days of the automobile, when only the very brave even contemplated operating an auto during the winter months? Long before the first snow the car was jacked up, tires removed,



Courtesy Central Specialty Co., Ypsilanti, Mich.

The Heater Is Built from Gray Iron and Aluminum Castings

and there it remained until the robins returned in the spring. Times have changed and winter now is no barrier to automobile driving, due much to perfection of design and the development of new features. The car heater is one of the many accessories which add to the comfort in cold weather. Various types of heaters are on the market, utilizing heat secured from several parts of the engine. An interesting type, which was placed on the market last fall, consists of two parts, as shown in the accompanying illustration, one being a cast iron manifold and the other an individual heating chamber of cast aluminum extending along the top of the manifold. Some units are made entirely of gray iron. Regardless of the type of car heater, it is interesting to note that castings in some form are used extensively in the construction of the unit.

Find Where Castings Can Be Sold

CONTENTS

FEATURE ARTICLES

	Page
Adapt Mechanical Equipment to Jobbing Foundry	28
Causes and Prevention of Pinholes in Aluminum Castings—By D. Hanson and I. G. Slater	31
Melts Gray and Malleable Iron in the Electric Furnace—By J. C. Bennett and J. H. Vogel	35
Casting Design Discussed By Philadelphia Founders	39
Basic Time Standards Can Be Used in Estimating Costs—By Richard H. Hansen and Harold T. Hansen	41
Who Should Lead in Prevention?—By Marvin A. Heidt	43
New Type Inclusion Depends on Manganese-Silicon Ratio—By F. J. Cook	44
Prevent Losses with Proper Gates and Risers—By Pat Dwyer	47
Bill Claims the Cupola Should Be Slagged—By Pat Dwyer	52
Blithely He Starts on Second Half Century	54

REGULAR DEPARTMENTS

Reader's Comment	40	**The Shakeout**	56
Questions and Answers on Foundry Practice	50	**Comings and Goings of Foundrymen**	57
Problems in Nonferrous Founding—By Charles Vickers	51	**Obituary**	58
The Foundry Family Photograph Album	55	**What the Foundries Are Doing**	61
		New Trade Publications	62

THE FOUNDRY is published semimonthly by the Penton Publishing Co., Penton building, Cleveland, O. Member, Audit Bureau of Circulations, Associated Business Papers and National Publishers Association.

Branch Offices: Chicago, Peoples Gas building; New York, 220 Broadway; Pittsburgh, Oliver building; Cincinnati, Schmidt building; Washington, National Press building; San Francisco, Alto building; London, Caxton House, Westminster, S.W.1; Birmingham, England, 14 New street; Paris, 9 Rue de Londres; Berlin, Burgstrasse 28, Berlin, C.2. Cable address, Irotrapen, London.

Subscription: United States and Mexico, $3.00 a year; Canada, $4 a year; Great Britain and other Foreign Countries, £1:0:0 a year; single copies 25 cents. Copies published three months or more previous to date of current issue, 50 cents each.

Copyright 1932 by the Penton Publishing Co.

Adapt M

Fig. 1—Machine Tool Casting Molded in Set of Dry Sand Cores

HAVING specialized in the production of power transmission machinery for all purposes over a period of 45 years, it is only natural to find that the Hill Clutch Machine & Foundry Co., Cleveland, should have developed and installed in its own plant some interesting examples of power driven machinery, also some interesting examples of the application of power outside the usual or orthodox lines.

Examples of both kinds may be noted in various parts of the plant which recently has been extended and rearranged to a considerable extent. The present description is confined to the foundry, a brick and steel building 121 x 242 feet, representing the last word in foundry development when it was erected and placed in operation. A comprehensive description of the foundry with its many ultra modern features appeared in THE FOUNDRY at that time several years ago.

In recent years the trend has been toward the acceptance of steadily increasing volume of so-called outside or general jobbing work and this in turn has been responsible for several innovations in equipment and methods. A considerable part of this outside work is for machine tools demanding castings of great accuracy and strength and in some instances with surfaces to resist wear. Semisteel mixtures with the steel content in some instances up to 65 per cent, are melted and poured into the molds for these castings. Melted at an extremely high temperature—2900 degrees Fahr. is claimed—and poured into dry sand molds, this metal assumes a pearlitic structure, shows great strength and density and the machined surface may be polished to the brilliancy of steel.

Three recently introduced pieces of equipment help to reduce operating cost and thus contribute in a marked degree to the continued operation of the foundry on an almost full time schedule—although with a decreased force—during the present period of business depression. The first is a transfer car for carrying materials and equipment into and out of the foundry on a standard gage railroad track. The second is an oven for drying molds beyond the former capacity, and the third is a mechanical device for preparing the sand. The three are set down in the foregoing order, not to indicate the order of their importance, but merely for convenience in presentation. Each one of the three is important in itself, but in addition the operation of each one is dependent to a certain extent on the operation of the other two, and all three are hooked up intimately with the general and usual daily operation of the foundry.

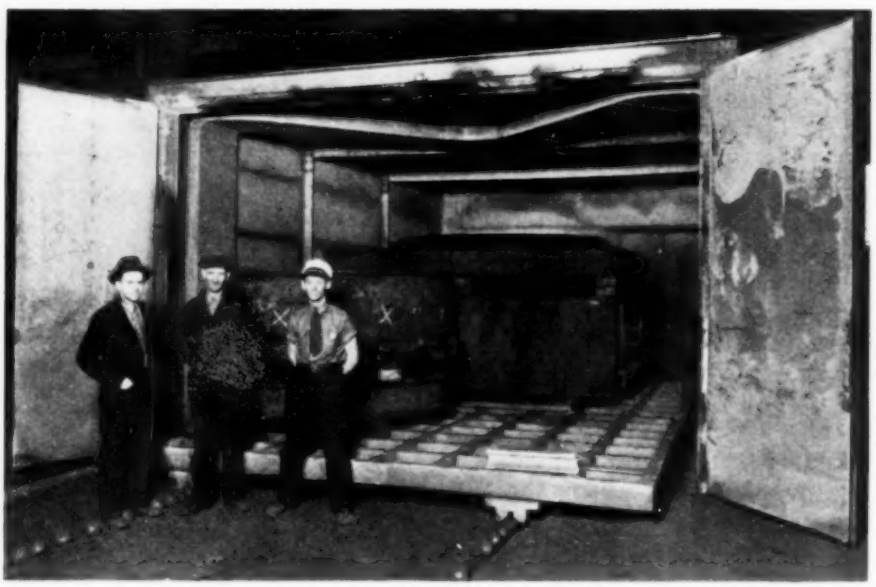


Fig. 2—Molds Loaded on a Pair of Cast Iron Cars Are Dried in a Steel Panel Oven Fired at the Back Through a Special Device

Mechanical Equipment To Jobbing Foundry

Construction and operation of the car were suggested by the fact that a spur from the New York Central railroad enters the yard of the Hill Clutch Machine & Foundry Co. Branches from this spur extend to all parts of the yard and one branch enters the foundry through a large door in the side near one end of the building. This branch extends through the cleaning room of the foundry and into the machine shop. In the foundry the track comes under the span of two cranes, one in the central and one in one of the side bays and facilitates loading.

Fig. 4—A Converted Automobile Truck Carries Equipment and Materials into and Out of the Foundry

The transfer car running on this track may be loaded or unloaded readily by either or both cranes, and may be loaded or unloaded just as readily by a locomotive crane constantly on duty in the yard.

In passing it may be said that this crane loads and unloads the transfer car, shunts railroad cars to any desired position in the yard, unloads pig iron, scrap, coke, limestone and sand. It lifts the materials for charging the cupola from stock piles in the yard to an open floor, on a level with the charging floor of the cupola. Sand is lifted from the cars with a grab bucket and discharged through chutes in the wall into bins on the inside of the building, core sand in the vicinity of the coremaking department at one end of the building and molding sand at the opposite end.

Possibly if the railroad tracks had not been in existence a different method might have been adopted, but with the tracks already laid and with the experience of a smaller self-propelled transfer car to serve as a precedent, the construction and operation of the present large unit may be regarded as the culmination of a process of evolution. A White truck was purchased for the purpose. Fortunately the gage on a pair of truck wheels is approximately the same as the standard gage on railroad rolling stock, 4 feet, 7 11/16 inches, therefore no change was needed on the axles. In fact all that was done was to remove the tires, turn a seat on the existing rims and then adjust cast iron flanged tires in place of the rubber tires. The tires were cast in the foundry from a hard iron mixture and under ordinary conditions probably will outlive the chassis. The face of the rim was not chilled,

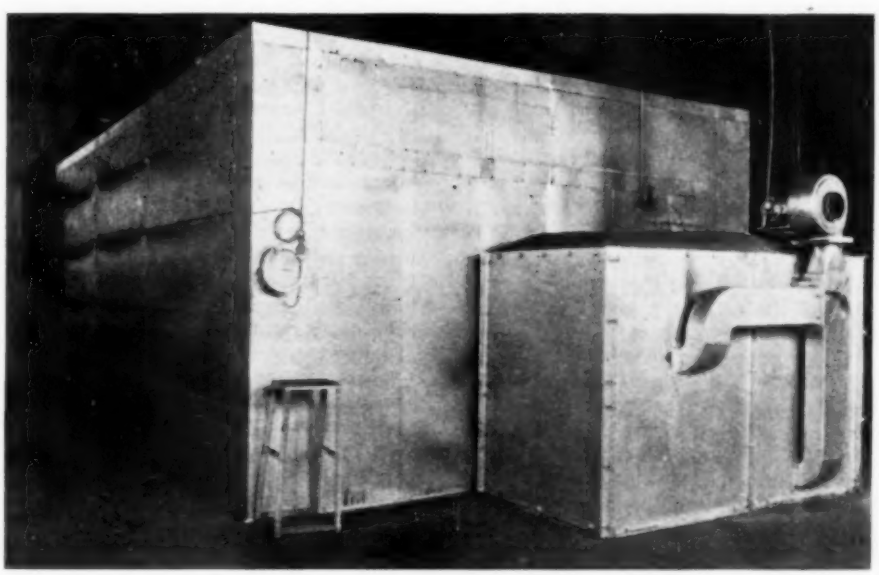


Fig. 3—The Firing Chamber at the Back of the Oven Is Provided with an Air Duct and Bypass for Admission of Air To the Oven

but was given a light cut in the machine shop to secure smoothness of operation.

The side beams of the chassis were extended 4 feet at the back and a light welded steel platform 7 feet 6 inches x 17 feet was attached to this frame. The driving gear was left intact with the exception that the steering apparatus was disconnected. Manifestly the driver of a flange wheeled vehicle running on a pair of rails, has no opportunity of making either right or left hand turns. The passage of the car is limited to the area covered by the network of railroad lines in the yard and which in this instance are connected to each other by suitable switches.

A typical load of approximately 10 tons, including empty flasks, over iron scrap and boxes of spent core sand,

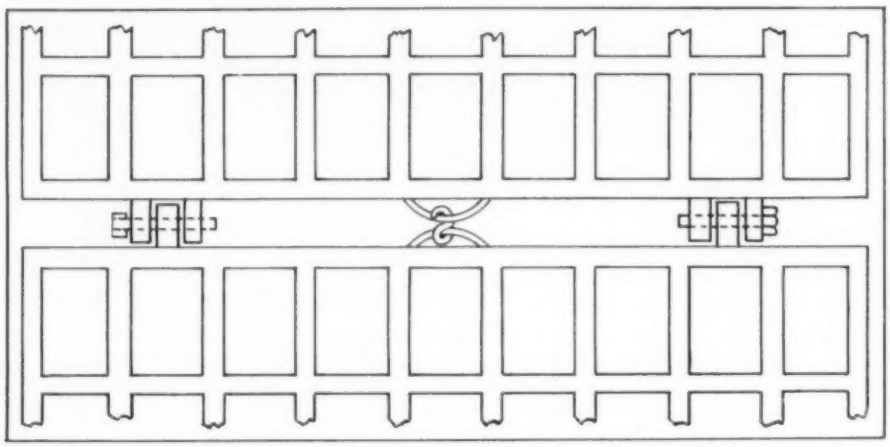


Fig. 5—Showing Detail of Simple Device for Hooking the Oven Cars Together

is shown in the illustration. Fig. 4. Up to the present no attempt has been made to test the ultimate capacity of the car. With iron wheels on steel rails it is apparent that the ultimate or total capacity is dependent on the strength of the platform rather than on the tractive capacity of the engine. In all probability, the engine will pull the maximum load the platform will support.

However, this is a remote contingency, since in the ordinary operation of the foundry, flasks and other materials are moved frequently in comparatively small lots.

Dry sand cores enter extensively into the construction of many molds in this foundry, hence the four loaded steel boxes of spent core sand shown in Fig. 4. The boxes are placed on the floor of the cleaning room where the sand is shoveled into them as it accumulates. One of the cranes places the loaded boxes on the transfer car. In the yard the locomotive crane empties the box in a place set apart for the purpose. Periodically this sand and other waste material are loaded by a grab bucket into railroad cars and hauled away by the railroad company for ballast and fills.

Crowded oven conditions in addition to a certain measure of dissatisfaction which always accompanies the attempt to dry molds and cores in the one oven, induced the management to install the oven shown in Figs. 2 and 3 for the express purpose of drying large molds. The oven was designed and erected by Young Brothers Co., Detroit, and presents many interesting features. It is 16 feet wide, 10 feet 6 inches high and 26 feet from front to back.

Double jack-knife doors with tapered edges insure a close fit. The walls and roof are No. 16 gage steel telescoping panels with 4 inches of rock wool insulation. With this form of construction the oven may be taken down, re-erected or changed in size should future requirements demand any of these changes.

Heat from the firing chamber on the outside enters the oven through a single opening near the bottom of the rear wall in the center. Gas and steam escape through two vent pipes with openings close to the floor, at the side near the door. One of these vent pipes may be noted in Fig. 2 also a continuation of the pipe against the ceiling where it joins the pipe leading from the other or—in the present instance—the right side of the oven. These vent pipes discharge into a stack on the roof, 18 inches in diameter and 30 feet high.

The heating unit, shown in Fig. 3 is located outside and with its side parallel to the rear wall of the oven. It includes both firing and combustion chambers adaptable to using coke, gas or oil. In this instance coke is used. Air from a small blower is discharged through a vertical duct with an opening under the grates in the ash pit. Openings from the ash pit lead air to the front wall and also over the coke fire bed. An adjustable bypass leads horizontally from the vertical duct as shown on the outside of the chamber, to a point close to where the heat enters the oven. With this bypass, the operator can regulate the amount of fresh air entering the oven without regard to the amount of coke burned in the firing chamber. It is claimed that with a full oven, a temperature of 700 degrees Fahr. can be attained in little over an hour.

The oven car in two sections, each section 12 feet square, is a plain open sand gray iron casting made in a mold in the foundry floor with no further equipment than a couple of straight edges and a corebox. A wall 8 inches high was built around a level bed 12 feet square and then a set of rectangular dry sand cores was arranged on this bed to form pockets divided by 3-inch walls. The mold was gated at both ends and the metal was poured from two ladles. The two sections of the car are alike and their flat, level tops constitute an eloquent tribute to the high temperature of the iron from which they were poured.

Equipped with coupling gear the cars may be used singly or in tandem. A cable reeved through a sheave anchored in the floor near the inner end of the oven, and through another sheave anchored in the foundry floor approximately 30 feet from the oven entrance, may be attached to the crane hook and utilized for pulling the cars into and out of the oven.

Moves on Ball Bearings

Instead of moving on wheels, the oven cars travel backward and forward on two rows of 5-inch cast iron balls set in paralll V-section cast iron ball races. Cast iron balls for turntables constitute a regular product of the foundry and those required for the oven cars were taken from stock. A pattern was required to make the molds for the ball races which are the same, top and bottom. The castings were poured in open sand molds. In addition to ease of operation, uniform support and low cost, this type of car provides maximum head room for the load. The upper race castings are attached to the cars and the lower ball races, set flush with the foundry floor, are supported on concrete foundations.

In one side floor bay the castings are dumped and the sand is reconditioned and made up on each floor in the usual manner. In the remaining two bays a different practice is followed. The molds from each bay are taken to one end of the shop where they are shaken out in one miscellaneous pile. The flasks are stacked, loaded on the transfer car, or returned to any designated place on the molding floor, depending on whether the job is finished or other castings are wanted on the same order.

This method presents two advantages. Closer and more accurate control can be kept over the preparation of the sand. The foundry floor can be kept in a cleaner and tidier condition. A third advantage also may be cited. Cost of mechanically preparing sand in bulk is less than where a limited amount is prepared individually near each mold by the

(*Concluded on Page* 34)

Causes and Prevention of Pinholes in Aluminum Castings

By D. Hanson and I. G. Slater

DURING the last few years several contributions have been made to the study of pinholes and their occurrence, particularly in sand-castings in the form of *speckled metal*. Budgen, *Journal*, Institute of Metals, 1929, has summarized many of the practical aspects of the problem, and has expressed qualitatively several of the factors which influence the occurrence of pinholes in sand castings, including composition of the alloy, melting, and casting technique.

Subsequent to Archbutt's discovery of *presolidification* for the removal of pinholes from aluminum alloy castings, several methods have been suggested, chief of which is a treatment with a stream of gas of the molten metal in the crucible immediately prior to casting. Rosenhain and Archbutt, *Journal*, Institute of Metals (London), 1925, in their experiments have shown that nitrogen can sometimes be used effectively while Tullis, *Journal*, Institute of Metals, (London), 1928, has examined the behavior of chlorine and has developed the use of boron trichloride.

Try Boron Trichloride

Treatment with boron trichloride is stated to be effective not only in removing pinholes, but also in conferring on the treated metal an exceptionally fine grain size, with resultant enhanced physical and mechanical properties. More recently Rosenhain, Grogan, and Schofield, *Journal*, Institute of Metals (London), 1930, have shown that titanium tetrachloride can be used in a similar effective manner on small experimental melts. Recent work in Germany by Claus, *Zeitschrift fuer Metallkunde*, 1929, has shown that pinhole-free castings may be obtained by maintaining the melt to be treated at a temperature just above its melting point in an electric furnace. Claus has also shown that water vapor has a deleterious action on molten aluminum alloy.

The opinion is held generally, and now seems to be quite acceptable, that dissolved gas is a principal factor in causing pinholes. The presence of dissolved gas in the melt may be ascribed to two major sources: First, from direct contamination of the melt by furnace fuels and products of combustion, and secondly, from the virgin metals used to make up the alloys.

Conduct Study

CONSIDERABLE trouble has been experienced from time to time with pinholing in aluminum sand castings, and the data presented in this article relate to experiments made to determine the causes of that trouble and the development of methods for prevention and elimination of it. This article is abstracted from a paper presented at the September, 1931, meeting of the Institute of Metals. Prof. Hanson is professor of metallurgy, The University, Birmingham, England, and Mr. Slater is research investigator, British Nonferrous research association, Birmingham, England.

The solubilities of various gases in solid and liquid aluminum have been determined by Sieverts, *Zeitschrift fuer Physikalische Chemie*, 1907, Iwase, *Science Reports*, Tohoku Imperial university, 1916, Bircumshaw, *Philosophical Magazine*, 1926, Czochralski, *Zeitschrift fuer Metallkunde*, 1922, and Guillet and Roux, *Comptes Rendus*, 1927. Hydrogen appears to have a greater solubility in molten aluminum than most gases, and is the main constituent of the gases evolved from samples melted *in vacuo*.

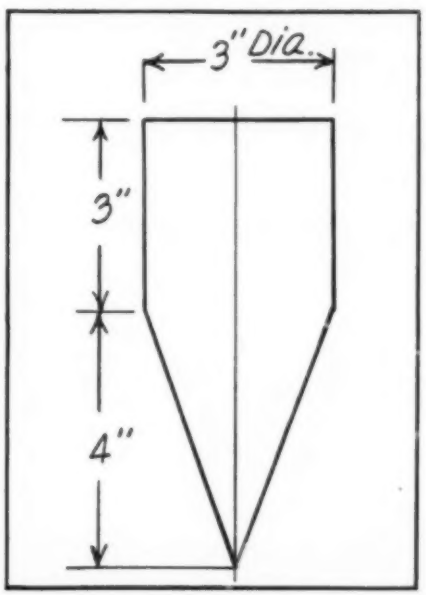


Fig. 1—Taper Test Specimen

At the beginning of this work a consensus of opinion on the problem was taken among several large aluminum founders. The only systematic attempts to remove pinholing, apart from the normal foundry control, have been made mainly on the lines of Archbutt's researches. Results reported have been variable. On the whole, treatment with nitrogen has been unsuccessful except in isolated instances, while treatment with chlorine appears to be distinctly more effective.

Method Involves Remelting

Presolidification apparently is more effective than nitrogen treatment, but involves remelting and consequently difficulties in preventing reabsorption of gases. The varying experiences of different foundries, the irregular incidence of pinholing, and the uncertainty of the remedies already suggested, indicate that all the factors involved have not been fully under control, or have yet to be defined.

Experiments which have been carried out both in the laboratory and in the large-scale foundry tests have been directed mainly to the determination of methods and conditions under which pinholes may be eliminated from aluminum alloy castings by treatment of the molten alloy prior to casting. The procedure adopted for the preparation of specimens for examination has been to cast some of the treated melt into skin-dried greensand molds, and the sectioning of the resultant castings for visual examination.

Experiments have been made principally with the "3L11" (8 per cent copper) alloy, but other alloys in general use, including "2L5" (13.5 per cent zinc, 2.75 per cent copper) alloy, "Y" (4 per cent copper, 1.5 per cent magnesium, and 2 per cent nickel) alloy, and 12 per cent silicon-aluminum alloy, as well as virgin aluminum, have also been used.

A study of the effects of various gases, including steam, nitrogen, chlorine, and mixture of nitrogen and chlorine, has been made. The addition of certain substances which have a

Table I

Density and Appearance of Standards

Ingot No.	Material	Treatment	Density	Appearance
5	U. "3L11"	None. Standard test casting	2.771	Moderate
17	M. "3L11"	None. Standard test casting	2.810	Moderate
12	V. Al	None. Standard test casting	2.673	Sound
71	M. "2L5"	None. Standard test casting	2.900	Moderate
72	M. "Y"	None. Standard test casting	2.714	Moderate
73	M. Si	None. Standard test casting	2.604	Moderate

high vapor pressure at temperatures above 700 degrees Cent. (1292 degrees Fahr.), or which have an affinity for hydrogen, also has been investigated.

To eliminate unknown effects due to contamination by furnace fuels and atmospheres, melting and treatment were carried out in an electric furnace of the resistance type for the laboratory experiments. A small 2-kilowatt electric furnace was adapted for the purpose, and a suitable top cover designed to arrange for the introduction of gases, as desired, either into the furnace atmosphere or into the melt contained in a crucible.

Use Taper Test Piece

A taper test casting having dimensions as shown in Fig. 1 was chosen, so that effects due to mass and cross section could be observed. The molds were made up from green-sand and were skin-dried thoroughly immediately before use. No mold dressing was applied, and the casting was poured large end up with an open top, permitting observation of the metal on cooling and of the amount of sink or pipe which occurs on solidification of the various alloys.

To supplement visual observation of unsoundness present, the density of each casting was determined by the usual method of weighing in air and in water (where large internal cavities were present, a half section was used). The castings were prepared by milling flat a longitudinal half section, and polishing on a power-driven disk, using coarse and fine emery cloths soaked in paraffin to prevent smearing of the surface of the section, a trouble which is likely to occur, especially with the softer alloys. The sections were finally etched with a 20 per cent solution of hydrofluoric acid in water swabbed on to the previously warmed surface. Etching not only served to reveal grain size, but also exposed more clearly to the observer the extent and nature of the pinholes present.

To avoid probably unnecessary duplication, the majority of the experiments have been made with the "3L11" (8 per cent copper) alloy. Two batches of that alloy were used; batch U, "3L11" being made up from electrolytic copper and virgin aluminum ingot in a 30-pound charge melted in a coke-fired plumbago crucible, and batch M, "3L11," a 200-pound charge melted from similar materials in an oil-fired iron pot furnace. Confirmatory tests have been carried out with "2L5" (2.75 per cent copper—13.5 per cent zinc) alloy (M. "2L5"), "Y" (4 per cent copper, 2.0 per cent nickel, and 1.5 per cent magnesium) alloy (M. "Y"), 12 per cent silicon-aluminum alloy (M. Si), and virgin aluminum (V. Al). These were obtained ready prepared and of uniform composition.

For the laboratory experiments, quantities of about 3 pounds were taken. From each batch of ingots a standard test casting was taken for purposes of comparison. This consisted of a 3-pound charge melted in the enclosed electric furnace and cast immediately at 700 degrees Cent. (1292 degrees Fahr.) without treatment. Details of density and appearance are given in Table I.

In all cases, except where indicated in the text, test ingots were cast at 700 degrees Cent. (1292 degrees Fahr.). Alloys of compositions not identical with the above were used for the large-scale tests. Particulars of these are given later, in the appropriate section.

Table II

Results of Steam Test on Specimens

Ingot No.	Material	Treatment of Molten Metal	Density	Appearance
5	U. "3L11"	None. Standard test casting.	2.771	Moderate
6	U. "3L11"	Atmosphere of steam for 1 hour.	2.728	Very bad.
7	U. "3L11"	Brisk stream of steam bubbled in for 1 hour.	2.221	Very bad.
8	U. "3L11"	Brisk stream of steam bubbled in for 3 minutes.	2.690	Very bad.
12	Virgin aluminum ingot	None. Standard test casting.	2.673	Practically sound.
13	Same	Brisk stream of steam bubbled in for 3 minutes.	2.469	Very bad.
14	"2L5"	None. Standard test casting.	2.934	Moderate
15	"2L5"	Brisk stream of steam bubbled in for 3 minutes.	2.788	Very bad.

Study Effect of Steam

In reviewing the facts relating to unsoundness in castings, both in aluminum and other metals, the observations made by Allen, *Journal*, Institute of Metals (London), 1930, on the influence of steam on molten copper indicated that a study of the effect of water vapor on molten aluminum would yield profitable information. Aluminum reacts with steam at elevated temperatures with the production of nascent hydrogen, and hydrogen is recognized as one of the principal gases in promoting unsoundness. The effect of water vapor is thus of importance, both in consideration of its presence in furnace atmospheres and in methods of gas treatment of unsound melts.

Steam generated in a can boiler was

Table III

Effect of Nitrogen Gas on Aluminum

Ingot No.	Material	Temperature of Treatment Degrees Cent.	Treatment	Density	Appearance
5	U. "3L11"	.....	None. Standard test casting.	2.771	Moderate.
9	U. "3L11"	700	Cylinder nitrogen—20 minutes.	2.741	Inferior to No. 5 Oxide inclusions.
10	U. "3L11"	700	Dry nitrogen—20 minutes.	2.795	Appearance better than No. 5.
11	U. "3L11"	700	Dry and oxygen-free nitrogen—20 minutes.	2.786	Better than No. 5.
17	M. "3L11"	700	None. Standard test casting.	2.810	Moderate.
34	M. "3L11"	630-640	Dry nitrogen—20 minutes.	2.814	Better than No. 17.

passed into the furnace atmosphere, the lead-in pipe terminating just above the surface of the melt, which was kept at 700 degrees Cent. (1292 degrees Fahr.). An ingot cast after treatment for 1 hour showed extensive pinholing. Further treatments were carried out by bubbling steam directly into the melt. This operation was accompanied by vigorous bumping and an appreciable rise in temperature.

Water Vapor Is Deleterious

In addition to the "3L11" alloy, the effect of steam on virgin aluminum ingot and on "2L5" alloy was determined, the temperature of the melt during treatment being maintained at 700 degrees Cent. (1292 degrees Fahr.) in each experiment. The results are summarized in Table II.

Effect of water vapor is seen to be exceedingly deleterious, rapidly promoting excessive pinholding and reducing the density of the castings. Much oxide is formed, especially after prolonged treatment with steam; in the case of No. 7 ingot a pasty mass was produced which was practically uncastable. Observation of the cooling metal in the mold showed that, whereas with the untreated melts a state of tranquility persisted, with the steam-treated melts a marked evolution of gas occurred just prior to solidification in the form of small watery-like bubbles.

The size of the pinholes in these ingots appears as a maximum towards the center of the ingot, and is much smaller near the edges and at the taper end. A few large isolated pinholes are observed almost on the edge of the section. These have been formed to occur in other instances, and are referred to later.

Reaction between steam and molten aluminum under the conditions mentioned is quite vigorous, especially when steam is bubbled into the metal, and it is supposed that some of the hydrogen formed passes into solution in the melt, while the oxide remains mechanically entangled. The liberation of this hydrogen on solidification is the cause of the pinholes in the final castings. These results confirm the conclusion reached by Claus, whose results were not published until after the above experiments had been completed.

Table V

Chlorine Gas Improves Appearance

Ingot No.	Material	Temperature of Treatment Degrees Cent.	Treatment	Density	Appearance
17	M. "3L11"		None. Standard test casting.	2.810	Moderate
18	M. "3L11"	700	Chlorine; moderate rate — 5 minutes.	2.810	Moderate
19	M. "3L11"	700	Chlorine; moderate rate — 20 minutes.	2.817	Better than No. 17.
20	M. "3L11"	700	Chlorine; very brisk rate—20 minutes.	2.802	Slightly worse than No. 17.
21	M. "3L11"	850	Chlorine; moderate rate for 20 minutes.	2.781	Slightly worse than No. 17.
27	M. "3L11"	630-640	Chlorine; moderate rate for 20 minutes.	2.827	Practically sound.

As already mentioned, the use of nitrogen and chlorine has previously been suggested for removal of gas from aluminum alloys, but experience in commercial foundries has shown that successful results are not always obtained. Therefore, the following experiments were undertaken with a view to obtain further information on the action of these gases. In view of the effect of water vapor, the question of the dryness of the gases appeared particularly to require further investigation.

Nitrogen gas obtained from the ordinary commercial steel storage cylinder was used. The gas may contain moisture, and arrangements were made for a drying train consisting of three large Drechsel washing-towers arranged in series and charged with concentrated sulphuric acid. Commercial nitrogen may also contain a small percentage of oxygen. In experiment No. 11 the nitrogen was freed from oxygen by passing the cylinder gas over fresh copper turnings heated to 850 degrees Cent. (1562 degrees Fahr.).

Gas Must Be dry

The gas was bubbled into the melt at a fairly brisk rate, with the inlet pipe reaching nearly to the bottom of the crucible containing the molten alloy. Details of the treatments made, with the results obtained, are given in Table III.

Necessity for using dry nitrogen is indicated clearly, since nitrogen as obtained from the cylinder has definitely damaged the alloy. Although the dried gas produces a distinct improvement in soundness, in no instance has treatment with nitrogen been effective in promoting complete soundness. It must not be concluded that nitrogen as obtained from the cylinder can never effect an improvement, since there is evidence to the contrary. It is probable that cylinder nitrogen

Table IV

Effect of Nitrogen and Chlorine Gases

Ingot No.	Material	Temperature of Treatment Degrees Cent.	Treatment	Density	Appearance
17	M. "3L11"		None. Standard test casting.	2.810	Moderate
23	M. "3L11"	700	Chlorine 10 minutes followed by nitrogen 5 minutes.	2.826	Practically sound.
35	M "3L11"	700	Chlorine 10 minutes followed by nitrogen 5 minutes.	2.805	Moderate
38	M. "3L11"	700	Chlorine 15 minutes followed by nitrogen 5 minutes.	2.805	Moderate
26	M. "3L11"	700	Chlorine and nitrogen in equal proportions—15 minutes.	2.816	Better than No. 17.
24	M. "3L11"	700	Chlorine and nitrogen in equal proportions—20 minutes.	2.830	Practically sound.
25	M. "3L11"	700	1 part chlorine: 6 parts nitrogen—20 minutes.	2.808	Moderate.
39	M. "3L11"	850	Chlorine and nitrogen in equal proportions—20 minutes.	2.820	Slightly better than No. 17.
63		650	Chlorine and nitrogen in equal proportions—10 minutes.	2.826	Practically sound.
71	M "2L5"		None. Standard test casting.	2.900	Moderate
77	M. "2L5"	650	Chlorine and nitrogen in equal proportions—5 minutes.	2.924	Little pinholing.
75	M. "2L5"	650	Chlorine and nitrogen in equal proportions—15 minutes.	2.940	Practically sound.
72	M. "Y"		None. Standard test casting.	2.714	Moderate.
79	M. "Y"	650	Chlorine and nitrogen in equal proportions—5 minutes.	2.743	Practically sound.
76	M. "Y"	650	Chlorine and nitrogen in equal proportions—15 minutes.	2.748	Practically sound.
73	M. Si		None. Standard test casting.	2.604	Moderate
82	M. Si	650	Chlorine and nitrogen in equal proportions—5 minutes.	2.610	Little pinholing.
74	M. Si	650	Chlorine and nitrogen in equal proportions—15 minutes.	2.628	Practically sound.

would improve very defective alloy, although it may damage gas-free metal, while it is also probable that the dryness of the commercial gas will vary. As will be shown later, other factors also enter into the problem.

Experiments were carried out exactly as those described previously for the nitrogen treatments, except that chlorine gas obtained from a storage cylinder was employed. During treatment with chlorine a fairly vigorous reaction takes place, dependent on the rate of gas treatment and the temperature of the melt. Flashes of incandescent material appear on the surface of the melt, which becomes covered with a white powdery dross of aluminum oxide produced from the decomposition of the chloride formed initially.

Some white fume is evolved, especially when the reaction is vigorous. Little chlorine gas escapes into the atmosphere, except with melts treated at the lower temperatures, since the melt readily absorbs and reacts with chlorine. A small evolution of gas from solidifying ingots was observed only in experiments Nos. 20 and 21. Details of the treatment are given in Table V.

Improves Soundness Slightly

Treatment for 20 minutes at 700 degrees Cent. (1292 degree Fahr.) with chlorine improves soundness only to a small extent. At 850 degrees Cent. (1562 degrees Fahr.) a less sound casting is obtained which has a large grain size. When treatment is carried out at 630 to 640 degrees Cent. (1168 to 1184 degrees Fahr.), a casting which is practically free from pinholes is obtained. In these experiments the original metal was not very defective, and it is possible that a more marked improvement would be found if inferior metal were treated.

Mechanism of the removal of dissolved gases from aluminum alloy melts by treatment with nitrogen is surmised to be one of a scavenging nature, in which the dissolved gases diffuse into the nitrogen bubbles and are carried away. It is improbable that nitrogen combines chemically with the dissolved gases and removes them in the form of a less soluble compound, and hence its efficiency will be a function of its ability to disturb the equilibrium between the melt and the dissolved gas, which will become more difficult as the gas content of the melt diminishes.

Bircumshaw, *Philosophical Magazine*, 1926, has suggested that the difficulty of removing gas dissolved in a metal is due to the relatively high surface tension of the medium in which the gas bubbles are formed. According to W. C. MacLewis, the ability of a metal to dissolve gas depends on the ability of the metal to dissociate it. Thus for removal of gas from a melt it is necessary to take into account both these influences.

Chlorine combines readily with molten aluminum, forming volatile aluminum chloride, and with most of the dissolved gases. The removal of dissolved gases by chlorine will thus depend on its chemical activity and the scavenging action of the aluminum chloride formed. It is observed that far superior results are obtained when melts are treated at temperatures just above their respective melting points. This is undoubtedly connected with gas solubility approaching a minimum at the melting point.

In two instances—with ingots Nos. 20 and 21—treatment with chlorine has had the effect of increasing the unsoundness present. While it is unlikely that chlorine may dissolve in molten aluminum without chemical combination, it may be possible that aluminum chloride may remain in solution.

A mixture of chlorine and nitrogen seemed likely to be a more efficient medium for the removal of dissolved gases than either of these elements used separately. An alternative would be to follow up treatment with chlorine by a further treatment with nitrogen. Both these methods have been tried, and the first has been found to give the more satisfactory results.

For introducing mixtures in known ratios of the two gases, they were led separately via their respective washing and drying trains into a final mixing bottle, and thence to the gas lead-in pipe. The relative proportions of the two gases were judged from the rate of bubbling through the wash towers. Treatment with the mixed gases is accompanied by reactions similar to those observed for chlorine, but with the evolution of a larger quantity of fume. Details of treatments made on four alloys are given in Table IV.

This is the first of three articles on the causes and prevention of pinholes in aluminum sand castings. The second will appear in an early issue.

Reports on Accidents

Statistics compiled in the statewide safety campaign of the Ohio Foundries association, according to A. H. Kramer, president, reveal a foundry accident for every 25,000 man hours worked. November reports from 133 foundries show 51 accidents among 10,671 employes who worked a total of 1,245,892 man hours, or an average of one accident for each 24,429 man hours. Twenty-four accidents resulted in less than 7 days lost time each, while 27 were over 7 days each. There were no permanent impairments or fatalities.

Fifty-nine plants reporting so far for December show 5010 employes worked 748,765 man hours with 30 accidents, an average of one accident for every 24,959 man hours. Sixteen of the December accidents resulted in less than 7 days lost time each, 13 were over 7 days each and one was a permanent impairment.

Mechanical Equipment in Jobbing Shop

(*Concluded from Page* 30)

molder or a helper with a shovel.

The sand conditioning apparatus made up of a large hopper, a number of screens and an endless belt, is mounted on a truck which in turn travels on a section of track extend- across the center and one of the side bays. The track occupies a space between the area where the molds are shaken out, and two pits, one in the main bay and one in the side bay.

In practice the shaken out sand is lifted by a grab bucket suspended from the crane and dumped into a hopper which conducts it in succession to several screens which remove lumps, gaggers, rods, scrap and all other foreign material. The prepared sand falls on to the endless belt which discharges into the pit, or if necessary directly into a tote box. A constant supply of prepared sand always is available in the pit. A grab bucket suspended from the crane conveys it to the molders at various points on the floor as it is required. In many instances the load from the bucket is deposited directly in the flask and thus eliminates slow and tedious shoveling.

Extent to which investigation into the properties and uses of sands has been carried is reflected in changed molding practice and in the appearance of many of the castings. Large molds that once were rammed slowly and carefully by hand, vented with a wire and supported on a coke bed, now are jolted on a molding machine, never touched with a wire and the coke bed has been eliminted. The result of course is due to the use of an open, free venting sand that requires no coaxing or coddling. All sand is purchased according to strict specification.

The same *show me* attitude has been responsible for the almost total elimination of risers on the majority of the castings. In a few instances risers are employed for showups, flowoffs and for feeders, but in the great majority of instances they have been discarded as useless and unnecessary. Experiment and investigation have shown that a mold made under proper conditions will produce a satisfactory casting even without the riser which in the majority of instances only represents a blind following of custom and tradition. Proper conditions means sand of high permeability, rammed hard in a rigid flask and also includes hot iron poured through a head high enough to create a reasonable pressure.

Unfilled orders for brass and bronze ingots and billets on Jan. 1 totaled 21,067 net tons compared with 21,753 net tons on Dec. 1, according to the Nonferrous Ingot Metal institute.

Melts Gray and Malleable Iron in the Electric Furnace

By J. C. Bennett and J. H. Vogel

THE furnace used in the malleable foundry of the York Ice Machinery Corp., York, Pa., is a 1-ton capacity unit of the rocking type made by the Detroit Electric Furnace Co., Detroit. The steel shell of the furnace has an outside diameter of 5 feet 9 inches and an overall length of 5 feet, while the corresponding inside dimensions are 3 feet 8 inches, and 3 feet, respectively. The shell is lined with a 4-inch thickness of insulating brick on which the refractory lining is laid. This consists of a refractory brick which is 8 inches in thickness.

Temperature reached by furnace walls often exceeds 3000 degrees Fahr., the temperature of the walls exceeding the pouring temperatures of the iron by at least 200 degrees. The temperature generated by the arc has been estimated at 6400 degrees Fahr. The carbon electrodes are 5 inches in diameter and 3½ feet in length, and are joined by graphite nipples. The electrode clamps are water-cooled and, in addition, there is a copper coil around each electrode adjacent to the furnace walls to keep the electrodes beyond this point as cool as possible.

The power input is controlled automatically to regulate the speed of melting. The desired rate is maintained by automatic adjustment of the distance between the elecrodes. This is done by a reversing motor which moves the electrodes together should the input fall below, or moves them apart should the input exceed the desired rate.

Procedure Explained

SOME time ago the York Ice Machinery Co., York, Pa., installed an electric furnace to melt both malleable iron and special gray iron for castings. Considerable interesting information, collected during the operation of the furnace, is contained in this article, which is abstracted from a paper presented at the Chicago convention of the American Foundrymen's association. The authors are metallurgist and assistant superintendent, respectively, of the York company.

The charge of raw material is placed in buckets and dropped in the door of the furnace, as shown in Fig. 3. An electric crane lifts the bucket which discharges the material into the furnace through the bottom.

In starting the furnace, the power is applied and the furnace rocked through an arc of about 45 degrees during the first 25 minutes of the heat, or until the charge partly is melted. Then the rocking arc gradually is increased to 160 degrees and the furnace is operated through that arc until the metal is ready to pour.

When the power consumption has reached the point where pouring is imminent, a reading of the temperature of the furnace walls is taken with an optical pyrometer, precaution being taken that the reading is made on the side or roof removed from the arc. If the temperature is not sufficiently high, the arc again is applied until the desired heat is obtained. The metal at the spout also is checked for temperature. Another test piece also is cast for fracture observation. This is shown in Fig. 6 and has sections 6 inches long with range from ¼ to 2 inches in diameter.

Prior to pouring the heat, a fracture bar, shown in Fig. 5, the thickness of which tapers from ⅜-inch down to ⅛-inch, is poured, cooled in water and broken. This determines whether or not any correction must be made to prevent excessive hardness in the castings. The necessity for this check and subsequent correction is due to the variation in the borings used as raw material.

Metal is tapped into a geared ladle holding about 700 pounds of iron, from which the floor work is poured, while snap flasks are poured from hand ladles fed by the large geared ladle. The time from charging the furnace to pouring the metal ranges from 80 to 85 minutes and, in less than 2 hours from the time the arc is applied, the heat has been tapped, the next

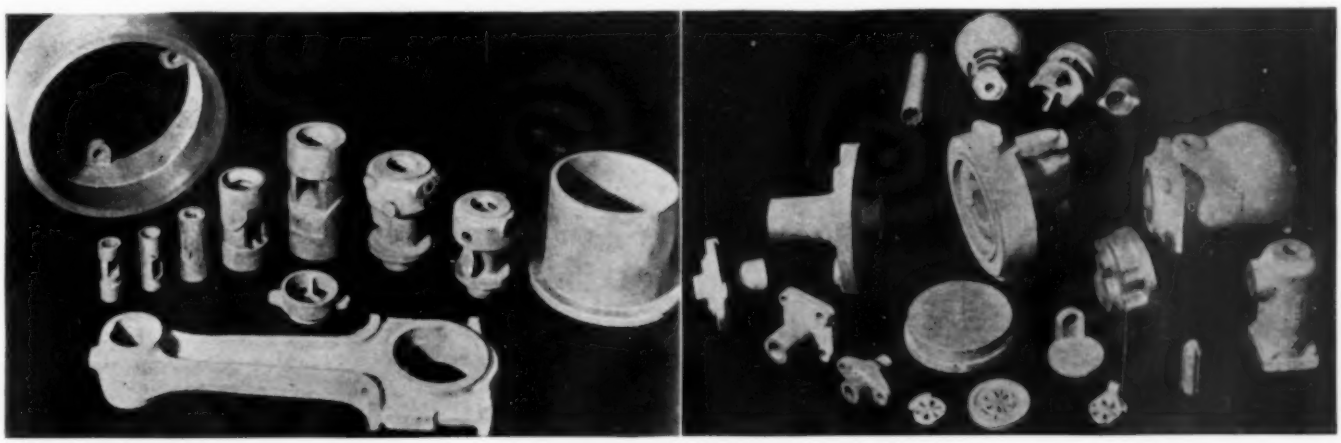


Fig. 1—Pistons, Cylinders and Piston Ring Pot Castings Made from Gray Iron Produced in the Indirect Arc Electric Furnace. The Connecting Rod Is of Malleable Iron. Fig. 2—Valve and Fittings Castings Used in the Construction of Ice Machines of Various Sizes

charge introduced and the arc started again.

One of the chief advantages of the electric furnace is its flexibility. For example, during one day's run of six heats, as many as four different kinds of iron, namely ordinary, gray iron for small pressure castings, low-carbon gray iron with 2 per cent nickel for manifolds, high-phosphorus iron for piston rings and malleable iron for large connecting rods have been poured.

	Per cent
Silicon	2.52
Sulphur	0.045
Phosphorus	0.207
Manganese	0.60
Nickel	1.93
Total carbon	3.22
Free carbon	2.68
Combined carbon	0.54

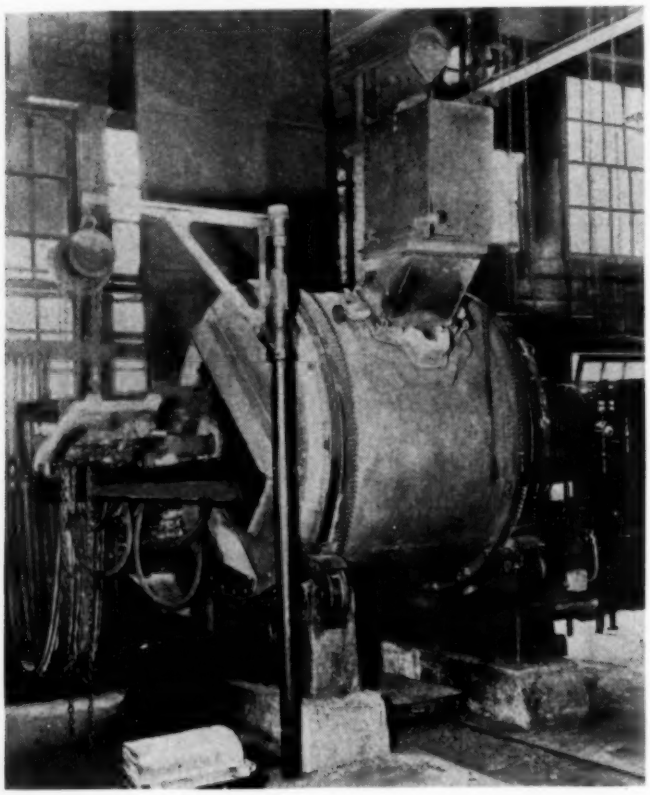


Fig. 3—The Furnace is Charged by Drop Bottom Buckets Which Have a Capacity of 700 Pounds. The Furnace Is Rotated Into a 45 Degree Position and a Funnel Is Hung on the Door Bolts, the Bucket Raised by an Electric Hoist, Moved to Position Over the Funnel, the Bottom Dropped and the Material Discharged Into the Furnace

A second advantage of the electric furnace is the cheap raw material that can be used. Our normal gray iron charges consist of 60 per cent cast-iron borings and 40 per cent scrap and sprue. The necessary ferrosilicon is added to prevent undue hardness and for certain classes of complicated thin-walled castings, steel is added to close the grain and 2 per cent nickel is used to prevent chilled sections.

Gives Properties of Iron

The properties of the gray iron heats made in the electric furnace are indicated by a report covering a number of test pieces cast from the same ladle of electric-furnace iron. Six, A. S. T. M., 1¼-inch arbitration bars were cast and broken for transverse strength, with the results shown in Table I. Coupons taken from these bars were then turned to the standard A. S. T. M. requirements for tensile testing and broken. Results are given in Table II. An analysis was made from the broken test pieces, and the report shows the following data:

The samples from which these results were obtained were taken from a heat for production castings and are representative of results which are obtained in our standard fitting heats.

For the production of large, malleable-iron, connecting rods, the electric furnace has been found to be an indispensable piece of equipment. The charge of metal as introduced into the furnace for these castings consists of 99 per cent malleable-iron sprues, our own accumulations, and 1 per cent steel scrap. This proportion keeps the analysis and quality of the iron constant.

Low-carbon iron requires high pouring temperatures, due to its tendency to freeze quickly. In the products manufactured by the York company the pouring temperature at the spout must range between 2900 and 3000 degrees Fahr. for sound castings. Through ladle transfer and the distance the iron is transported, the heat loss is about 200 degrees. The high temperatures obtained at the mold gives the iron fluidity, thus allowing proper feeding through the risers and permitting the escape of gas. The annealing cycle applied to this malleable iron is that which is standard for malleable iron, namely, 1600 degrees Fahr. for 60 hours and a cooling rate of about 4 degrees per hour until 1200 degrees Fahr. is reached, when the oven doors are opened and the castings are allowed to cool.

The successful performance of the connecting rods necessitates inspection of both white and annealed castings. The greatest cross-section of these rods is about 3 square inches, and this section must be free absolutely from primary graphite. The annealed castings machine readily.

Strength Is High

A report covering 25 heats of our electric-furnace malleable iron, as given by the Malleable Iron Research institute, show the following averages: Tensile strength, 57,480 pounds per square inch; yield point, 38,330 pounds per square inch; elongation, 22.1 per cent in 2 inches. Average white iron analysis of these heats was as follows: Silicon, 1.10 per cent; sulphur, 0.043 per cent; phosphorus, 0.14 per cent; manganese, 0.29 per cent, and carbon, 2.10 per cent. Products of the York company foundry vary greatly in weight and section, ranging in weight from 2 ounces to 300 pounds and from ¼-inch to 2 inches in thickness. Fig. 2 shows an assortment of valves and fittings. Fig. 1 shows a grouping of pistons, cylinders, piston-ring pots, a valve disk and a malleable- iron connecting rod. Fig. 4 shows four manifold castings.

Because of the possibility of using the cheapest raw material available, the cost of iron manufactured in the electric furnace at the spout can be brought down to a figure which compares favorably with the cost of iron when melted in an air furnace or a cupola. The following data on costs were accumulated over a 3-month period during which time 300 heats were run. Subsequent checking has shown that these figures are in the main

Table I

Transverse Tests on Electric Furnace Iron

Bar No	Brinell at center	Diam. of bar, in inches	Deflection, in inches	Transverse strength, in lbs.
1	207	1.270	0.135	4510
2	201	1.234	0.156	4640
3	207	1.237	0.153	4620
4	201	1.236	0.130	4210
5	197	1.270	0.132	4330
6	207	1.265	0.128	4270

representative. All costs given are per ton of iron poured and are based on a melting loss of 2 per cent, which have been established as correct.

The greatest cost per ton is chargeable to power. Average kilowatt-hour consumption is 610 per ton at a cost of 1.3 cents per kilokatt-hour, or $7.93 per ton of iron. This may seem high, inasmuch as 600 kilowatt-hours per ton usually is considered a good average figure. However, it must be remembered that this 610 kilowatt-hours includes all power used for preheating, etc. Normally, the daily average is 580 kilowatt-hours per ton, the first heat of the morning running approximately 610 while the last heat of the day usually drops to 550. Malleable heats average slightly greater kilowatt-hour consumption, probably due to the higher pouring temperature. Our normal power input is at the rate of 400 kilowatts.

Describes Patching Operations

The second cost in order of importance is refractories for which the best average cost to date is $2.55 per ton of iron poured. This figure includes all furnace operation expense items which are chargeable to refractories, including the insulating lining, the refractory lining, both material and installation labor and all patching labor and material.

The method of patching the furnace is worthy of mention. Normally the last heat of the week is made on Friday afternoon. As soon as the iron is out, the furnace is turned with the door up, the electrodes removed and the discharge line from a small electric blower is inserted in one electrode port and the other port plugged. This blower discharge line has a deflector on the end which forces the air toward the bottom of the furnace. The blower is run continuously until Sunday morning, when the patching is done. Incidentally, this blower also is used to force fresh air into the furnace while the workmen are inside patching. This makes it possible for them to remain in the furnace as long as an hour, instead of 15 minutes.

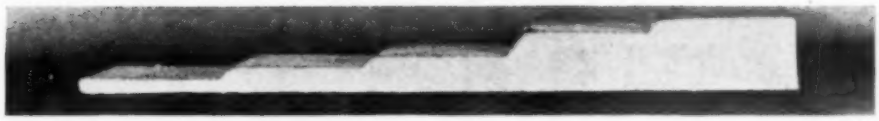


Fig. 5—A Fracture Test Bar Is Cast To Determine If Adjustment Is Necessary To Prevent Excessive Hardness in the Castings

Before applying the patch, all burned material is chipped out with an air hammer and the sides of the remaining walls are under cut as much as possible to key in the patch. The patch then is applied approximately ¾ to 1-inch thick and rammed in place with an air hammer.

No attempt is made to maintain the original furnace dimensions by building up the wall. The reason for that procedure is that the patching material, having practically no bond, will have little strength unless thoroughly sintered, and apparently the heat does not penetrate a thick patch sufficiently to accomplish this at the back. Consequently, the thick patch breaks out instead of gradually wearing away as the thin, well-fused patch does. This applies only to the brand of patching material used in this case.

After the patching is completed, the furnace is allowed to air dry until Monday morning, or, if the patching has been excessive, a slow coke fire is started at once and kept going until Monday. Monday morning, prior to charging, the furnace walls are heated to 3000 degrees Fahr.

As would be expected, the roof of the furnace fails first, inasmuch as it is subjected to the arc without any protection for a longer time than any other portion of the lining. To lessen this tendency, the furnace now is being operated upside down at the start of the heat for approximately half the number of heats. In addition to saving the roof, this method of operation also prevents the accumulation of slag on the bottom. To prevent electrode breakage due to this procedure, the furnace is charged, rolled over and then the electrodes are inserted.

A curve, showing refractory cost per ton against tons charged, is plotted to determine at any time the status of the lining. A sample curve is shown in Fig. 7. The cost per ton is derived by dividing the total lining and patching cost to date by the total tons charged to date.

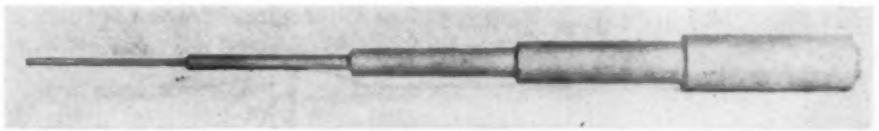


Fig. 6—A Telescopic Test Bar Also Is Cast and, When Fractured, Its Structure Is Studied

This curve, in addition to giving at any time our refractory cost per ton, also indicates the need of relining should this occur before the apparent total failure of the lining. For instance, should the curve rise consistently it indicates that the lining is in such bad shape that the excessive patching costs are increasing the refractory cost per ton. Therefore, it is advisable to reline even though the lining apparently is good.

Breakage Due to Carelessness

The third item of expense is chargeable to electrodes. The furnace operated by the York company averages 9.7 pounds of electrodes per ton, at a cost of $0.1875 per pound or $1.82 per ton of iron poured. Electrode breakage is almost entirely the result of carelessness in handling the furnace and has been reduced to a minimum through attention to the condition of port holes and proper manipulation, especially at start of heat.

Labor cost averages $1.40 per ton of iron poured. One man spends full time on the furnace; a second assists in charging and pouring. Labor cost is high but cannot be reduced materially for one furnace.

The method of charging is simple and effective. Bottom-dump buckets holding 700 pounds are used. These buckets are loaded in the pig iron storage and brought to the furnace by electric trucks. Prior to charging, a steel funnel is hung on the door bolts and the furnace rotated until the

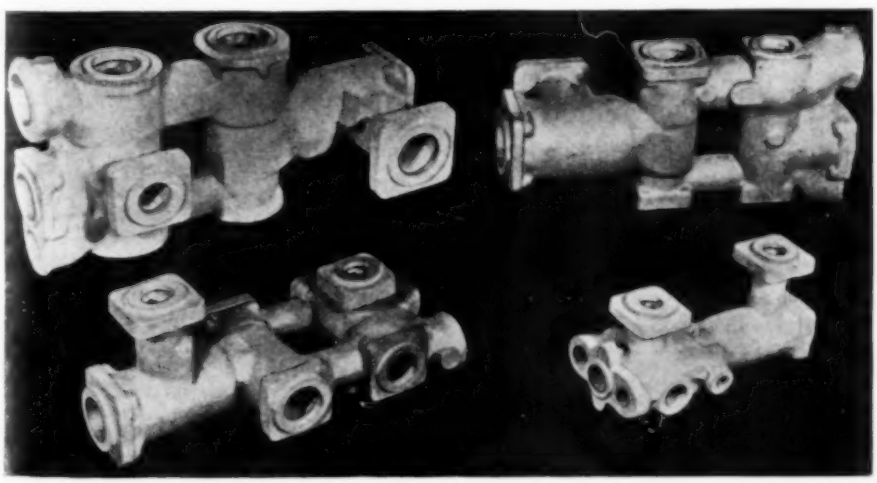


Fig. 4—Manifold Castings Poured from Iron Melted in the Electric Furnace

Table II

Tensile Tests

Bar No.	Dia. of bar, in inches	Tensile strength in lbs. per sq. in.
1	0.8	33,000
2	0.8	34,800
3	0.8	32,000
4	0.8	32,600
5	0.8	32,600
6	0.8	29,600

door is in the 45-degree position. The bucket is raised by an electric hoist, moved into position over the funnel and the bottom dropped. With these buckets it is possible to charge one ton metal in less than 5 minutes. Borings are charged first to cushion as much as possible the blow of the heavier pieces of the charge on the bottom. These buckets are used for all material charged, with the exception of an occasional piece which is too large to go through the bucket opening.

Summary Of Costs

A summary of the above costs is as follows:

Power	$7.93
Refractories	2 55
Electrodes	1.82
Labor	1.40
Interest, depreciation and repairs	2.00
Total	$15.70

Normal gray iron charges consist of 60 per cent borings at $6.50 per ton, and 40 per cent of our own scrap at $14 per ton. The necessary ferrosilicon averages $1.25 per ton, making a total material cost per ton of $10.81. This brings the total cost per ton at the spout to $26.51, or 1.325 cents per pound.

Apply Satin Finish to Aluminum Castings

A satin finish gives a texture and luster to an aluminum casting surface that has slightly less reflectivity for light than a highly polished surface, according to a bulletin, "Specifications for Architectural Finishes Applied to Aluminum Alloy Sand Castings," published by the Aluminum Co. of America, Pittsburgh. That finish depends upon the formation of fine scratch lines as obtained by the use of various grades of abrasive or by a wire brush wheel.

To produce a satin finish the casting first must be polished. After the use of the No. 180 emery the surfaces are buffed using muslin or felt wheels with grade N greaseless polishing compound. Other grades of greaseless compounds give a coarser or finer finish, depending upon grain size of the abrasive employed in such compounds. The resulting finish, if correctly applied, results in a fine satin surface. A still finer finish may be obtained by using a rotary fiber brush or rubbing by hand with a paste made of pumice and oil.

If the surface of the casting, after the basic polishing operation using No. 120 and 180 emery, be buffed using a muslin or felt wheel and polishing grease, a satisfactory base for a wire brush satin finish is assumed. On large flat surfaces a fine mild sandblast before wire brushing becomes quite essential to maintaining a uniform satin appearance. Before using the wirebrush on the prepared surface, both the surface and the brush must be cleaned of grease and dirt thoroughly with a suitable solvent or by preheating a half hour at 400-600 degrees Fahr.

A 6-inch diameter wire brush made up with nickel, stainless steel, or German silver wires 0.004 to 0.010-inch in diameter and operated at a speed of 450 to 600 revolutions per minute is used to give the desired satin appearance. As with the wire brush finish, these wheels should be cleaned frequently with pumice stone or a soft brick to insure continued uniformity. The wheel likewise should be reversed on the driving shaft from time to time to keep the wires sharp.

A finish closely approximating the true satin finish can be obtained with a belt sander when the surface conditions permit the use of this equipment. By using belts of No. 80, 120, 180, and 240 emery and a belt speed from 2400 to 3000 feet per minute, a finely cut surface is produced. By hand finishing with pumice or steel wool and kerosene a still finer finish is obtained.

Loadings of revenue freight for the week ended Jan. 9 totaled 572,504 cars, an increase of 69,179 cars over the preceding week, according to a report of the car service division of the American Railway association.

Steel Castings Company Elects Officers

The Detroit Steel Castings Co., Detroit, completing 30 years of corporate life, has renewed its charter for a like period under Michigan laws. Coincident with the renewal the following officers have been chosen: John S. Newberry, chairman of the board; S. W. Utley, president and general manager; J. M. Duncan, vice president sales; F. A. Melmoth, vice president operations; W. S. Allen, secretary; J. P. Warren, treasurer; J. R. Burgess, assistant treasurer.

Plans Annual Contests for Apprentices

The committee on apprentice training of the American Foundrymen's association has authorized the annual A. F. A. contest for foundry apprentices to be held in connection with the 1932 convention and exhibition in Philadelphia. Apprentice contests will cover pattern making, gray iron molding and steel molding.

Preliminary contests will be held in various sections of the country and the winning entries in the local contests will be sent to Philadelphia where they will be exhibited during the week of May 2-6. At that time, contest judges will select the final winners for each contest. Prizes for the best work in each of the three groups will be awarded.

The contests are open to any local organization or individual desiring to enter apprentices. Several district foundry groups take an active part in urging their members to enter apprentices. Rules and regulations for the contest may be obtained through Robert E. Kennedy, technical secretary, American Foundrymen's association, 222 West Adams street, Chicago.

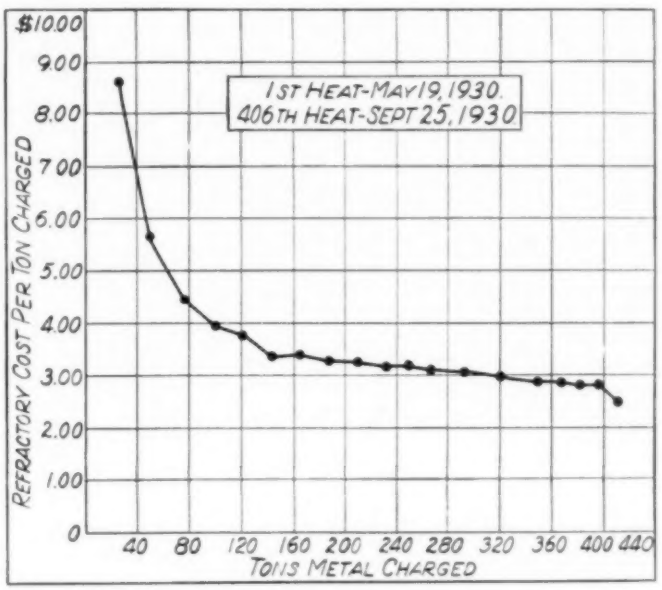


Fig. 7 — Curve Showing the Cost of Refractories Per Ton of Iron Charged for a 1-Ton Electric Furnace

Casting Design

Discussed by Philadelphia Founders

CASTING design was the subject of an animated discussion at the joint meeting of the Philadelphia Foundrymen's association and the American Foundrymen's association held at the Manufacturers' club, Philadelphia, Jan. 13. The meeting drew an attendance of more than 125 and marked the fortieth anniversary of the local

J. B. Greenstreet

organization, the oldest of its character in America.

H. J. Rowe, Aluminum Co. of America, Pittsburgh, lead in the discussion of design of aluminum castings; B. H. Johnson, R. D. Wood & Co., Philadelphia, and former president of the Gray Iron institute, of gray iron castings; and K. V. Wheeler, Lebanon Steel Foundry, Lebanon, Pa., of steel castings. E. H. Ballard, president of the American Foundrymen's association and superintendent of the foundry and pattern shops, River works, General Electric Co., West Lynn, Mass., a guest of honor, presided through the courtesy of Julian B. Greenstreet, president of the local organization, and superintendent of the Olney Foundry Co., Philadelphia.

All speakers stressed first and foremost the desirability of closer co-operation between foundrymen and designers and the need for as much simplification of design as possible. Progress in those directions is sure to lead to substantial savings and sounder castings, it was declared. Mr. Ballard stated no patterns should be used until they had received approval, as to their practicability, by the foundry.

Declaring that aluminum alloys were relatively new compared with most other casting metals, Mr. Rowe enumerated their more important characteristics, in relation to their bearing on design: (A) Low specific gravity; approximately one-third that of iron or brass. (B) Hot shortness; material weakness at temperatures below the solidification point. (C) High crystallization shrinkage; change in volume from liquid to solid state. (D) Linear shrinkage; change in dimensions with change in temperature in the solid state.

Discussing general factors in the design of aluminum alloy castings, the speaker said that regardless of type of pattern equipment, draft and shrinkage considerations must be taken into account. He declared also that pattern lines should be made as even as possible; that the jig spots to be used by the machine shop should be clearly marked; and that much of the cost of producing is dependent to a large degree on the ease with which the castings can be cleaned and trimmed.

Mr. Rowe said that many castings now being made in dry sand might be made in green sand molds, had the idea been considered in the original casting design, and that this also applies to many cores in present castings. Where it can be used, green sand is desirable in point of economy.

His further discussion covered questions relating to core prints, chaplets, inserts, section thickness limitations, design of ribs, fillets, machine finish allowances, welding and soldering, and pattern equipment. He concluded with an outline of factors relating to the cost of production, emphasizing that the ultimate success or failure of producing castings actually starts with the design.

Keen competition from without as well as from within the industry, makes it essential for gray iron founders to pay the utmost attention to questions of design, according to Mr. Johnson, as they are fundamental for cheaper and better castings. He thought designers stood in need of closer knowledge of foundry practice, and that therefore, it was particularly essential for foundrymen to extend the fullest possible co-operation.

He touched on such phases as adaptibility to machine shop practice and simplicity in design. Loose pieces on a flask should be avoided when possible. He spoke of shrinkage, for which proper allowance should be made. Section thickness

E. H. Ballard

should be as near uniform as possible, and gating, which influences shrinkage, should be given due consideration in design.

Important parts or surfaces, Mr. Johnson continued, should be brought to the attention of the foundrymen. Surfaces which must be free from sponginess, where possible should be cast in the drag. It is important for the designer to bear in mind whether one casting only or many will be made from a pattern.

A pattern should be designed so as to give the casting the greatest strength with the least amount of metal, and should provide walls sufficiently thick to allow the metal to flow easily. Iron, he warned, must not solidify while running through the mold. Casting edges should be rounded with good fillets inside.

Discussing steel castings, Mr. Wheeler said that one cause for faulty design is that no one ever has, and probably never will, establish definite limitations of the found-

ry art in producing sound castings of intricate shape. Further difficulty, he said, lies in the fact that occasionally clever foundrymen produce sound castings of complicated design, thereby setting up a precedent in which commercial considerations are sacrificed to pride in craftsmanship, in the desire to obtain an immediate order.

Mr. Wheeler gave consideration to both the mechanical and metallurgical phases, the latter influenced by the manufacturing peculiarities of the metal, which are different in different branches of the industry. He said that a real problem in the consideration of design is not so much on how the metal gets into the mold, as what it does after it arrives in the mold cavity.

He said that cast steel of normal carbon content shrinks about 9 per cent, of which 3 per cent is accounted for by liquid contraction. Risers used to counteract shrinkage can function only if a proper temperature differential is maintained between casting and riser, in which the riser is the last point to solidify. He discussed the difficulty arising where heavy sections cannot be fed, due to light metal sections interposed between them and the risers.

Reader's Comment

EDITOR'S NOTE—*Material Appearing Under This Head Does Not Necessarily Reflect the Opinion of* THE FOUNDRY *or of Its Editors.*

Out of Courtesy

TO THE EDITORS:

Referring to Mr. Gates' comment in the Jan. 1 issue of THE FOUNDRY, relating to omitting the word *sand* from sandblast nozzles, please note the enclosed circulars printed for this company about 2 months ago in which you will notice we have followed this line of thought. It occured to us to do this out of courtesy to makers of steel abrasives.

W. H. THOMAS

Direct Separator Co. Inc.
Syracuse, N. Y.

EDITOR'S NOTE—The advertisements and circulation matter of this company refer to blasting equipment and use the term *"blast nozzles."*

Must Be Grounded

TO THE EDITORS:

I noticed in the department devoted to "Questions and Answers on Foundry Problems" on page 50 of the Jan. 1 issue of THE FOUNDRY a brief item entitled "Sand Developed Static." This short article was of particular interest to the writer because he is called upon, many times during a year, to give advice on this subject. The remedy mentioned helps in a few rare cases but, unfortunately, often has been found useless.

A few weeks ago the writer was called in on a case where a wire was run around the hose and attached, as stated in the article, to the sandblast machine proper, which was in turn grounded to an *industrial railway track*. The static electricity was so severe that the operator positively refused to operate the machine. The writer then disconnected the copper wire from the sandblast tank, stopping it at the end of the hose, and connected, at this point, a heavily insulated wire which was led to the ground. We then started up the equipment and found it was absolutely free from static.

This method proved so successful in this particularly severe case that the firm with which I am associated has made up a blueprint sketch, which it is sending to any customers who experience trouble along this line.

As stated in the article, the static electricity is caused by friction between the abrasive (sand) and the inside of the hose. The amount of static electricity created seems to bear some relation to the velocity of the abrasive mixture as it travels through the hose, which points toward a simple remedy. In many cases operators permit a nozzle to wear out so that a tremendous flow of air and abrasive rushes through the hose. The larger the nozzle area with respect to the hose area, the more static electricity will be created, and it has been found that if the hose diameter is from 3½ to 4 times the nozzle diameter, little trouble with static electricity is experienced. When atmospheric conditions are such that they seem to enhance the creation of static electricity, the use of a smaller nozzle often will eliminate this. If, owing to the amount of work to be turned out of the blast, it is not practical to use a smaller nozzle, as this would materially reduce production, it then may become a question of using a larger hose.

I am sending you this information because I believe that it is a subject of vital interest to many users of sandblast equipment.

WM. A. ROSENBERGER,
Asst. Chief Engineer.

Pangborn Corp.
Hagerstown, Md.

British Group Postpones American Meeting

In view of the disturbed economic and financial conditions prevailing in Europe and America, the council of the British Institute of Metals has found it necessary to postpone the 1932 American meeting, which was to have been held in the United States and Canada next autumn. The meeting had been planned with the close co-operation, as prospective hosts, of the American Institute of Mining and Metallurgical Engineers. The council's suggestion that the meeting be postponed was received sympathetically by the American organization, and the assurance has been made that the members of the British organization will be welcome at such later time as may suit their convenience. An announcement regarding the institute's place of meeting next autumn will shortly be made.

In spite of the difficult economic conditions that have prevailed throughout the world during 1931, the British Institute of Metals finished the year with a net gain in its membership of 72, as compared with a net gain in 1930 of 38, thus making the total membership 2232.

Appoints Committee on Exhibits

E. H. Ballard, president, American Foundrymen's association, has appointed an advisory committee of 15 members for the 1932 foundry and industrial exposition, to be held in Philadelphia, May 2 to 6. The personnel of the committee is as follows: W. J. Coane, Ajax Metal Co., Philadelphia; O. D. Connover, Foundry Equipment Co., Cleveland, S. F. Courter, Carborundum Co., Niagara Falls, N. Y.; A. B. Fritts, Norton Co., Worcester, Mass.; R. W. Hisey, Osborn Mfg. Co., Cleveland; Thomas Kaveny, Herman Pneumatic Machine Co., Pittsburgh; Martin H. Kidder, Link-Belt Co., Chicago; H. L. McKinnon, C. O. Bartlett & Snow Co., Cleveland; C. T. McLoughlin, General Electric Co., Schenectady, N. Y.; Robert M. Maull, Tabor Mfg. Co., Philadelphia; P. J. Potter, Pangborn Corp., Hagerstown, Md.; H. S. Simpson, National Engineering Co., Chicago; H. S. Thoenebe, American Engineering Co., Philadelphia; R. T. Turner, Shepard Niles Crane & Hoist Co., Montour Falls, N. Y.; W. B. Wallis, Pittsburgh Electric Furnace Corp., Pittsburgh.

Index of foundry equipment orders for December was 20.9 compared with 17.2 in November, according to a recent report of the Foundry Equipment Manufacturers association.

Basic Time Standards
Can Be Used in Estimating Costs

By Richard H. Hansen and Harold T. Hansen

IN THIS highly competitive era the margin of profit is small at its best, and close figuring is required to get work. The danger of taking a job at a loss is ever present unless means are provided to predetermine costs accurately before work is accepted and production is started.

Past cost records cannot, as a rule, be used in predetermining labor costs as it is impractical and expensive to maintain cost records in sufficient detail for the accurate figuring of the cost of a new article. Even though cost records are kept of each operation and suboperation they can be used for comparison only, and as every operation has a peculiarity of its own which makes accurate comparison practically impossible, some other method must be used.

Charts Simplify Work

Basic time standards made up in chart form, covering all suboperations, have been found to afford a quick and accurate method for estimating the cost of new work, for setting budget costs, and for setting piece work or premium rates. The standards are obtained through accurate time study and the use of established engineering data.

The advantages apparent in basic time standards are: (1) Costs can be predetermined and budgeted. (2) Estimates on new work can be made quickly and accurately. (3) Piece work and premium rates can be set without timing each individual operation. (4) A good cost clerk, with no mechanical training, can make estimates and set piece work rates on any job after the plant executive has designated what equipment will be used.

Basic time standards are not new. Some manufacturers have established standards and have used them for several years. In most cases those standards cover only so-called productive operations, they do not include nonproductive labor because of the difficulty encountered in establishing a factor giving the true relationship between time and the work to be performed.

However, it is possible to apply basic standards to any class of work. Such difficult and varying work as tool, machine and die designing has been put on a wage incentive basis. Those standards were worked out by proper technical time study through which a factor was developed whereby it was possible to arrive at the time required to complete any given design.

Time Study Men Eliminated

Standards are especially valuable to manufacturers whose work does not come through in large quantities, as is the case of jobbing foundries which may be called upon to turn out only a few pieces of a particular design. With basic time standards, rates can be set before the work enters the plant, regardless of the quantity to be run. Thus, time study men are not required. If they were retained they would find it extremely difficult to catch each operation on each small lot that was

Table I

Extra Peen Cope and Drag—Chart No. 4

CROSS PEEN ONCE ACROSS LENGTH AND WIDTH OF FLASK. TIME IN DECIMAL MINUTES

Size Flask	Time	Size Flask	Time	Size Flask	Time
12x14	0.0832	12x32	0.1408	13x22	0.1120
12x16	0.0896	12x34	0.1472	13x24	0.1184
12x18	0.0960	12x36	0.1536	14x14	0.0896
12x20	0.1024	13x13	0.0832	14x16	0.0992
12x22	0.1088	13x14	0.0864	14x18	0.1024
12x24	0.1152	13x16	0.0896	14x20	0.1088
12x26	0.1216	13x18	0.0992	14x22	0.1152
12x28	0.1280	13x19	0.1024	14x24	0.1216
12x30	0.1344	13x20	0.1056	15x15	0.0960

Note: Allow 0.0032 decimal minutes per lineal inch for all peening except cross peening shown above and peening around outside of mold which is included with standard elements, Chart I.

Table II

Tuck Pockets—Chart No. 3

TIME IN DECIMAL MINUTES

Cubic Content Pocket	1 & 2 Pockets	3 & 4 Pockets	5 & 6 Pockets	7 & 8 Pockets	9 & 10 Pockets
1	0.02	0.04	0.06	0.08	0.10
2	0.03	0.06	0.09	0.12	0.15
3	0.04	0.08	0.12	0.16	0.20
4	0.05	0.10	0.15	0.20	0.25
5	0.06	0.12	0.18	0.24	0.30
6	0.0648	0.1296	0.1944	0.2592	0.3240
7	0.0696	0.1392	0.2088	0.2784	0.3720
8	0.0744	0.1488	0.2232	0.2976	0.3960
9	0.0792	0.1584	0.2376	0.3168	0.4235
10	0.0847	0.1694	0.2541	0.3388	.....
11	0.0896	0.1792	0.2688	0.3584	.....
12	0.0945	0.1890	0.2835	0.3780	.....
13	0.0995	0.1990	0.2985	0.3980	.....
14	0.1014	0.2028	0.3042	0.4056	.....
15	0.1094	0.2188	0.3282	0.4376	.....
16	0.1143	0.2286	0.3459	.....	.....

put through the plant at one time.

For the purpose of setting rates, standards can be developed and maintained at less than the cost of time studying each operation, and the standards have an additional advantage in their use for estimating. Charts have been developed covering the following work done in a jobbing malleable foundry: (1) Molding. (2) Pouring. (3) Hard Iron milling, sorting, and weighing. (4) Hard and soft iron grinding. (5) Laborers. (6) Melting. The same charts can be used in all foundries using the same type of equipment as that upon which the charts were based. With a different type of equipment, new charts will have to be made.

Develop Time Standards

For the purpose of illustrating the method of developing time standards in the foundry the operations of molding and pouring will be considered. The primary information required for establishing the basic standards is obtained through a great number of detailed time studies covering the various suboperations in the different classes of molding. The studies are divided into classes according to the equipment being used.

Next graphic charts are made to permit the comparison of the time, (in decimal minutes, for each element in the time study), with one other factor such as weight or the cubic content of the mold. In cases where time cannot be made to agree with one factor, other factors must be tried until the graphic chart is made to show a consistent curve.

Record Results Immediately

In developing factors showing a true relationship between time and the work to be performed it is best to record the results of the time studies on the charts as the studies are taken. In this way the facts are fresh in mind. Hence, the factors can be obtained more readily as reasons for slight variations above and below the indicated curve can be analyzed easily and the true curve plotted. By the indicated curve we mean the curve passing through the greatest number of points (indicating time) on the chart.

Tabular charts made from the graphic charts will show the time in decimal minutes required to complete each element (suboperation) necessary to complete a mold up to the point of pouring. The total molding time is obtained by adding together the times in decimal minutes for each suboperation.

The time is given in decimal minutes so that each element of a study can be checked with a stop watch. Some might prefer the tabular charts to show the cost of each operation instead of the time. The disadvantage of that method is that all the figures would have to be changed each time the labor market fluctuated, when the charts show time, any wage rate can be used.

There are 12 charts in a complete set covering molding and pouring. They are arranged somewhat similar in form to Tables I and II which represent charts Nos. 4 and 3 respectively. Chart No. 1, for example, gives the actual time in decimal minutes for all operations that are standard, that is to say, operations which must be performed in making any mold, (the equipment used must be the same of course).

Time for those standard elements is controlled by flask size, area, cubic content of flask, and the weight of the mold. All of the controlling factors are shown in the column designations of the chart 1. Due to the difference in time for assembling and removing snap and strip flasks the total time for all standard elements is given for both types of flask, and the time must be selected for the type of flask used.

Use Number Designations

To conserve space in the column designations of chart No. 1 all of the elements are given a number in molding sequence as follows:

1. Walk from molding floor to machine or bench.
2. Assemble pattern and snap flask.
3. Assemble pattern and strip flask.
4. Dust with parting.
5. Riddle.
6. Fill drag with sand.
7. Peen drag.
8. Level off and place bottom board.
9. Jolt.
10. Roll over.
11. Dust with parting.
12. Riddle.
13. Fill cope with sand.
14. Peen cope.
15. Level off.
16. Place squeezer board.
17. Squeeze.
18. Remove squeezer board and cut sprue hole.
19. Lift cope and clean sprue hole.
20. Draw pattern.
21. Place cores.
22. Assemble cope and drag.
23. Remove snap flask.
24. Remove strip flask.
25. Carry mold to floor.
26. Clean pattern.

Of the elements listed only numbers 2, 3, 4, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 22, 23, 24, 25, and 26 are standard suboperations that are performed on all molds, a separate tabular chart must be worked up for each of the others. The numbers for the standard elements appear in the column designations of chart No. 1 and the total time for all of the standard elements, plus

MOLDING ESTIMATE

PRELIMINARY INFORMATION

PATT. NO.	A-2235-B	CUSTOMER	
FLASK SIZE 12 X 16 X 6" Cope 6" Drag.		AREA 192	CU. CONTENT 2304
NO. IN MOLD 2	CASTING WEIGHT 3.89	MOLD WEIGHT 10.67	

NO. OF CORES	DESCRIPTION	SIZE	TOTAL AREA
2	Core laid in horizontal position	3/4" Sq. x 3"	1 9/64

REMARKS

STANDARD ELEMENTS AND SUMMARY		SPECIAL ELEMENTS	
ELEMENT	TIME	ELEMENT	TIME
TOTAL ACTUAL TIME Using Snap Flask	——	RIDDLE DRAG 3½" (= A+B)	.058
TOTAL ACTUAL TIME Using Strip Flask	1.7981	EXTRA PENING DRAG (Cross Pene)	.0896
TOTAL ACTUAL TIME Special Elements	.7331	RIDDLE COPE 4" (= A+B)	.064
TOTAL ACTUAL TIME Standard & Special	2.5313	EXTRA PENE COPE (Cross Pene)	.0896
ALLOWANCE PER CENT 47%	1.22	LIFT COPE AND CLEAN SPRUE 4"	.1487
TOTAL STD. TIME DECIMAL MIN	3.7512	DRAW PATTERN 3½"	.1202
TOTAL STD. TIME DECIMAL HRS.	.0625	PICK UP & POSITION CORES	.0364
POURING TIME DECIMAL MIN.	.7233	SET CORES 3/8" deep	.0266
POURING TIME DECIMAL HRS.	.0120	ALLOWANCE FOR CORES (Square Core)	.06
TOTAL MOLDING & POURING TIME	.0745	Jack/pocket (3cu inches)	.04
HOURLY BASE RATE	.80		
MOLDING PRICE PER MOLD	.05	Total Time	.7331
POURING PRICE PER MOLD	.01		
MOLDING & POURING PRICE	.06	ESTIMATED BY R. H. H.	DATE 5/15/31

Total Time Shown Multiplied by Wage Rate Gives Mold Production Cost

an allowance for fatigue, is shown in the body of the chart.

Flasks that are either too bulky or too heavy for one man to handle are marked with an asterisk. In such cases the time for elements 1, 10, and 26 also must be allowed for the helper. Molds weighing more than 250 pounds necessitate carrying the cope and drag to the floor separately, and the molder will require help to lift the cope from the pattern. Therefore time for elements 1 and 26 must be doubled and added to time for elements 10, 17, and 22 as helper's allowance.

Includes Fatigue Allowance

Chart No. 1 also includes an allowance for fatigue which is based on each molder pouring off his own floor. That allowance is materially reduced when continuous pouring is possible, or when other help is available for the pouring operation.

Charts Nos. 2 to 12 inclusive give the time in decimal minutes for all operations that could not be included in chart No. 1 because they are not operations that are performed on every mold and therefore, they are not standard elements. Those charts are given the following titles:

No. 2—Riddle sand.
No. 3—Tuck pockets in cope or drag.
No. 4—Extra peen cope and drag.
No. 5—Lift cope and clean sprue.
No. 6—Draw aluminum plate pattern.
No. 7—Core classifications.
No. 8—Pick up and position cores.
No. 9—Set cores into core print.
No. 10—Extra to be added to core setting rates.
No. 11—Taking metal from spout.
No. 12—Pour mold taking metal from bull ladle.

A chart showing the area of circles will facilitate figuring the grasping area of cores and a chart giving the conversion of decimal minutes to hours will speed estimating work.

The molding estimate form shown in the accompanying illustration is filled out to indicate how basic time standard charts actually are used. The preliminary information required is filled in under that heading and notations are made opposite special elements giving data needed for obtaining the time from the charts. It then is a simple matter to complete the estimate by referring to the twelve charts. The total time shown in the estimate multiplied by the wage rate gives the cost of producing the mold.

The times in decimal minutes that were taken for certain operations in making up the sample estimate are shown in the respective tables. The remainder of the times written into the estimate were obtained as readily from other charts mentioned but not included in this article due to their length. Such an estimate can be relied upon thoroughly as the estimator is in no way called upon to use his own good, or bad, judgment.

Who Should Lead in Prevention?

By Marvin A. Heidt

SAFETY industry is indeed an essential factor which must be recognized by management and workers alike, but the responsibility for that safe operation— for that clean slate at the end of each month, absolutely must rest in one quarter. I feel that the logical and fitting center about which the whole movement revolves should be focused at the door of management.

The duty of management is to direct labor in safe operating. Each man should know the whys and wherefores of his particular job. He should be warned of its hazards and instructed in the proper way to avoid them. Safety instruction should be provided in such a way that the employee accepts willingly and appreciates that it is in his interest and for his protection.

Management is responsible for the condition of equipment. What a useless thing after an accident is the excuse, "I knew that that bar needed tightening but, with production as it is, I couldn't tie up the job." How many of you have had that said to you or have actually used it as an alibi yourself? An executive should never feel that he has the privilege to allow a faulty operation to continue. Stop the job— tie up production if necessary. Harsh words for this kind of a tie up are easier to stand than the accusing eyes of a widow or a permanently crippled man a constant burden to relatives.

Safe Operation

EVER since mental and physical labor have been combined to produce, the questions of safe operation and accident prevention have been uppermost in the minds of most industrial leaders. The consciousness that such a program was necessary and vital to the economics of industry has grown to its present proportion mainly in the past 25 years. This presentation is abstracted from a paper by Marvin A. Heidt, director of personnel, Budd Wheel Corp., Detroit, read at the annual meeting of the National Safety congress held in Chicago Oct. 12 to Oct. 16.

We will take as a basis for our contention, that management is responsible for quality and for the upkeep of the production schedule. The actual accomplishment of both the necessary quality and quantity depends on the employe. The good will of the employes, their feeling of responsibilty on their particular part of the whole program, the knowledge that they are being protected and helped to the utmost by the management— these things are going to grease the wheels of production and help achieve its proper quality and quantity.

The executive in selecting his associates in the safety program must appreciate the important part that these persons will take in this work and should select them on merit only. Too frequently the superannuated employee is selected to function in safety work. Though these men believe in the movement themselves, they just don't seem to be able to get the idea over to the men or impart the proper enthusiasm to them. If an executive has clear vision and is right in his demands upon those coming under his direction, the entire organization will be efficient and will cooperate toward the common goal— that of accident prevention.

Management must teach the employee to think, talk, and—greatest of all —act safely. In this lies the root of accident prevention.

Again the responsibility of safety lies with the management in that insurance rates are based on experience in the plant. The only person who is in the position to control the experience of that plant is the employer himself. He alone can decide whether the various operations in the shop shall be conducted with all possible safety or whether it shall be run with other considerations in view, that will push a safety program into

(*Concluded on Page* 49)

New Type of Inclusion Depends on Manganese-Silicon Ratio

By F. J. Cook

AN INCLUSION in cast iron of bright, glazy patches, which does not appear to have been recorded by any other worker recently has been observed by the author.

The phenomenon first was met in some locomotive steam cylinders and consisted of bright, glazy patches which became evident to the naked eye when the cylinder bores were machined. These patches, which varied in size, were not always found in the same relative place, nor adjacent to parts of varying thickness. They usually were associated with some part of the cylinder barrel remote from the valve-chest side, and where the metal was of even section.

Cylinder Metal Is Affected

The area and degree of glazy inclusion of the affected parts varied from cylinder to cylinder, and in some of the worst cases the areas appeared to be associated with spongy, open-grained metal. Examination with a low-power hand glass showed that the open appearance was due to small crystals of the inclusion having been torn out during machining operations, for the outline of crystal facets were seen plainly in the holes, which gave the spongy appearance.

The foundry in which the phenomenon first was encountered is run on scientific lines with a large chemical laboratory, well equipped and fully staffed, and where daily chemical analyses as well as physical tests of the cylinder-metal cast are taken and logged under a distinguishing number correspondingly cast on each cylinder. Within a few days of commencing an investigation into the trouble with these locomotive cylinders, the author was called to a similar trouble at another works in connection with some small ammonia compressor cylinders used in assemblies designed for refrigerator work.

Describes Formation

RECENTLY a new type of inclusion in cast iron has been observed in cylinder castings of various types. The formation has the appearance of a spongy mass and is not evident until the castings are machined in the bore. Investigation by the author, who is vice president, British Cast Iron Research association, has disclosed that the formation of the inclusion depends upon the ratio of the manganese and silicon contents of the iron. This article, which is abstracted from a paper presented at the Chicago convention of the American Foundrymen's association, also gives information on the contents of the inclusion.

Subsequently, the phenomenon also has been observed in diesel cylinder heads of Continental make, and in marine and general steam-engine cylinders made in five different foundries in Great Britain and on the Continent. Some of the cylinders have been cast vertically, others horizontally.

The investigation first was commenced by examining individually more than 100 cylinders available and noting which were affected, and the intensity of the trouble. Chemical analyses of the metal showed that the trouble was most intense in castings in which the silicon and manganese were of approximately equal amounts.

Affected by Low Silicon

The analyses of typically bad examples are given in Table I. This table is arranged, for easy reference, in order of the silicon content of the metal of various classes of castings.

Included in the table is a column giving the difference between the silicon and manganese contents. Silicon is invariably in excess of manganese in British irons, but the difference often diminishes as lower and lower silicons come into use.

Glazy areas became apparent in every case where the manganese was within 0.4 per cent of the silicon, and the condition increased in intensity as the difference between the two elements became less. The worst case

Fig. 1—Unetched Specimen of Iron Containing Inclusion Showing Glazed Areas, Magnified to 75 Diameters. Fig. 2—Same Specimen Unetched but Magnified to 200 Diameters

was that of example No. 9 in Table I, where the manganese actually was higher than the silicon.

Table II gives examples indicating the border line. With a difference between the silicon and manganese of 0.45 to 0.47 per cent, only occasional bright spots of the inclusion occur and with a difference of 0.5 per cent silicon or higher, the phenomenon disappears.

In example 26 of Table II, no sign of glaze was observed in the machined face of the casting, but minute traces were observed under the microscope in a piece of metal from the runner.

Examples Nos. 11 and 12 of Table I, and 24 of Table II, are of three large marine-engine low-pressure cylinders, weighing approximately 20,000 pounds each. Nos. 11 and 12 were cast by the time the investigation was commenced.

When No. 12 was machined there were evidences of the trouble. At this stage, the author had come to the conclusion that the trouble was associated with a manganese content which was within 0.4 per cent or less of the silicon content.

The analysis for No. 11 was found to be such that, if this theory was correct, there should be more glazy inclusion than in No. 12, and when the casting was machined this proved to be the case. In arranging for the metal for No. 24, care was taken to keep the ratio of manganese to silicon outside the danger zone, and the cylinder eventually proved to be free from the trouble.

Manganese Content Varied

In the case of the foundry making the locomotive cylinders, there was a tendency for the manganese content of the metal to vary unduly. The cause of this was traced and rectified, and the trouble disappeared.

In the case of the foundry making ammonia compressor cylinders, (example No. 15, Table I), the mixing of the metal was by rule-of-thumb methods. When commencing to make this type of casting, a composition of about 2 per cent silicon was aimed at and, as this would have a tendency to give a rather open-grained metal in the thicker parts of the casting, an addition of ferro-manganese was included in the charge to remedy this.

Table I

Analyses of Bad Examples

Example No.	TC	GC	CC	Si	Mn	S	P	Si-Mn
1	3.3			0.83	0.8	0.08	0.2	+0.03
2	3.27	2.67	0.60	0.92	0.7	0.14	0.33	+0.22
3	3.24	2.2	1.04	0.95	0.79	0.105	0.31	+0.16
4	3.36	2.26	1.1	1.03	0.77	0.130	0.34	+0.26
5	3.48	2.3	1.18	1.12	0.93	0.108	0.36	+0.19
6	3.36	2.33	1.03	1.26	1.05	0.10	0.42	+0.21
7	3.51	2.61	0.9	1.26	1.20	0.083	0.41	+0.06
8	3.45	2.61	0.84	1.26	1.14	0.087	0.32	+0.12
9	3.3	2.29	1.04	1.26	1.38	0.24	0.51	—0.12
10	3.36	2.55	0.81	1.31	1.1	0.105	0.44	+0.21
11	3.27	2.76	0.51	1.26	0.97	0.098	0.37	+0.29
12	3.03	2.36	0.67	1.36	0.98	0.12	0.36	+0.38
13	3.24	2.23	1.01	1.45	1.14	0.10	0.43	+0.31
14	3.45	2.58	0.87	1.45	1.17	0.072	0.48	+0.28
15	3.1			2.01	2.0	0.09	0.46	+0.01

NOTE: Example 1, diesel cylinder head.
Examples 2-10, inclusive, locomotive cylinders.
Examples 11-14, inclusive, marine-engine steam cylinders.
Example 15, ammonia compressor cylinder.

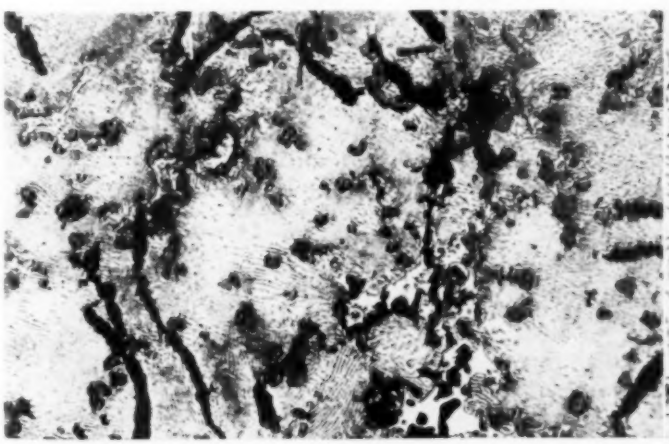
The addition of manganese originally added gave about 1.5 per cent in the casting and was successful for some time. Eventually, however, owing to the cumulative action of the increasing amount of manganese in the scrap and shop returns, a point was reached which brought the manganese-silicon ratio within the danger zone. By lowering the manganese content to 0.5 per cent below the silicon content, example 25, Table I, the trouble was eliminated.

So far as the author is aware, no trouble has arisen owing to bad wearing properties of any of the cylinders. However, on the hydraulic test, there is a tendency for the water to sweat through the glazed areas, and after the test, brown lines appear around the crystals. It also has been observed that when the cylinders have stood some time, after machining and before hydraulic testing, the glazed areas have a tendency to take on a brown tint.

Photomicrographs of glazed areas, taken from example No. 8, Table I, but which are typical of all, are shown in Figs. 1, 2, 3 and 4. Fig. 1 is at a magnification of 75 diameters, unetched. The glazy inclusion is indicated by small half-tone particles. These are associated with relatively fine flake graphite in clusters. This formation of the graphite is an outstanding characteristic of all examples so far examined, which includes many more examples than those given in Tables I and II. Fig. 2 is of one of glazed areas shown in Fig. 1, at a magnification of 200 diameters, unetched, and shows the clustered graphite more distinctly.

Exerts Stabilizing Effect

Fig. 3, at 200 diameters, and etched in picric acid, shows clustered graphite and stabilized cementite in the vicinity of the glazy inclusion. This stabilizing effect upon the cementite of not allowing the pro-eutectoid cementite to decompose may be affected by the presence of either sulphur or manganese. The pearlite has been thrown slightly out of fo-



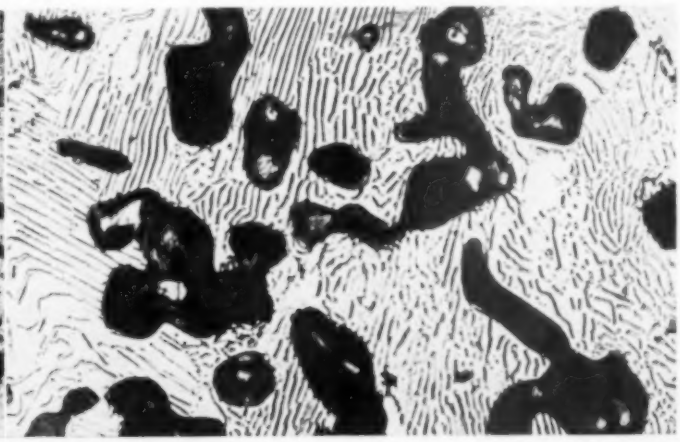


Fig. 3—Same Specimen as in Fig. 2 Etched with Picric Acid and Magnified to 200 Diameters. Fig. 4—Same Specimen, Lightly Etched with Picric Acid Magnified to 1000 Diameters

cus to accentuate the inclusions.

Fig. 4, which has been etched lightly in picric acid, is at a magnification of 1000 diameters and shows the typical formation of the inclusions. The black dots in the dark inclusion areas are holes left by particles torn out during polishing, and the white markings in the same areas are due mainly to high lights from the illumination.

Although an alteration in the amount of manganese cures the trouble, the question remains as to the identification of these inclusions and the reason and method of formation. Carl Benedicks and Helge Lofquist, in their book on *Non-Metallic Inclusions in Iron and Steel*, state that there are two kinds of slag inclusions; (a) Slag inclusions due to reactions taking place in the molten and solidifying metal which may be called native slag particles and which Hubbard in 1911 called sonims, solid nonmetallic impurities, and (b) mechanically a mixed slag inclusions and reaction products, respectively, between these and the native slags. These may be termed foreign slag particles. As the inclusions under review appear to be directly connected with the chemical composition, there is reason to consider them as belonging to the first class, for, if they are due to the second, they would be expected to be found in castings irrespective of their composition.

Table II

Analyses of Border-line Examples

Example No.	TC	GC	CC	Si	Mn	S	P	Si-Mn	Remarks
16	3.39	2.48	0.91	1.21	0.74	0.099	0.4	+0.47	Practically clear, 1 small spot.
17	3.3	2.36	0.94	1.31	0.63	0.125	0.27	+0.68	Quite clear.
18	3.42	2.47	0.95	1.31	0.78	0.09	0.39	+0.53	Quite clear.
19	3.39	2.46	0.93	1.36	0.6	0.114	0.29	+0.76	Quite clear.
20	3.42	2.67	0.75	1.4	0.95	0.098	0.56	+0.45	Practically clear; 2 small spots
21	3.36	2.34	1.02	1.4	0.98	0.073	0.32	+0.42	Practically clear; 3 small spots
22	3.42	2.45	0.97	1.5	1.0	0.105	0.44	+0.5	Quite clear.
23	3.39	2.48	0.91	1.54	1.07	0.075	0.02	+0.47	Practically clear 1 small spot
24	3.33	2.43	0.90	1.36	0.56	0.10	0.27	+0.8	Quite clear.
25				2.03	1.5			+0.53	Quite clear.
26	3.34	2.37	0.97	1.19	0.72	0.115	0.62	+0.47	No trace in bore, but traces found in runner gate

NOTE: Examples 16-23, inclusive, locomotive cylinders.
Example 24, marine-engine cylinder.
Example 25, ammonia compressor cylinder.
Example 26, steam-engine cylinder.

Inclusion Identification Difficult

Since the intensity of the phenomenon appears to be in direct ratio to the silicon and manganese present, and not in any way to the ratio of sulphur and manganese, and also that the shape and color of the inclusions are quite different from those usually associated with manganese sulphide, there is reason for believing that the inclusions are in the nature of manganese silicate.

It is difficult to see, owing to the small amount of sulphur present, that so large an amount of manganese sulphide could be formed. The inclusions do not have either the characteristic angular form of manganese sulphide, nor its dove-gray color. Neither do they resemble inclusions suspected to be double sulphides of iron and manganese.

If the glazy areas were manganese sulphide, difficulties in machining would arise, and this does not occur. If the areas were manganese sulphide why do they not occur in every instance quoted and also in the many cylinders which were found to be quite free? There is plenty of manganese present in each case to satisfy fully the sulphur present in the proportion to form manganese sulphide.

Dr. Stead has stated that manganese silicate can be distinguished from manganese sulphide by subjecting the micro-specimens to heat treatment. If heat treated, manganese sulphide will remain bright and manganese silicate will become dark. On an application of this test to the specimen shown in Figs. 1 to 4, glazed particles remained white. Further, it was noted that, when subjecting the specimen to dilute sulphuric acid, bubbles of gas were driven off, which in all probability are H_2S and which is always associated with the presence of manganese sulphide. Sulphur prints also showed distinctly the presence of sulphur.

An attempt was made to determine the composition of the inclusions, by dissolving a piece of the affected metal with the hope that the inclusions would remain while the iron, etc., would be dissolved. However, results were not satisfactory. While there was distinct evidence that a slag was present, there was not sufficient residue to make a complete analysis, nor could one be quite sure that the residue was the inclusion.

Since the ratio of manganese to silicon and not the manganese to sulphur, has a direct bearing upon the inclusions, the solution of the problem may be that a manganese silicate is formed and that this has a great affinity for and attracts sulphur, thus forming an alloy containing manganese, silicon and sulphur. Why, under the conditions stated, the phenomenon arises, is not quite clear. Nevertheless, it is a significant fact that in a large quantity of cylinders examined, not a single example has been found in which the glazy inclusion is not present when the silicon is not 0.5 per cent or more above the manganese content, and not a single instance where it has occurred when the silicon has been in this proportion.

Considers Second Theory

Benedick's second, or mechanically admixed slag inclusion definition, is worth consideration in relation to the present problem. It has been stated previously that the attempt to separate and analyze the inclusions was not considered satisfactory because it was not certain that the residue actually was the inclusion, and also that the amount obtained was too small, 0.3 gram, to make a complete and check chemical analysis. An analysis showed the following:

Compound	Per cent
Silica (SiO_2)	50.35
Ferrous oxide (FeO)	7.98
Alumina (Al_2O_3)	8.93
Manganous oxide (MnO)	19.38
Lime (CaO)	2.00
Magnesia (MgO)	11.25
Total	99.89

These data not only show the substance to be in the nature of a slag but also suggests that it consists of contamination by the furnace or ladle lining. The MnO content of 19.38 per cent is much more than usually is found in a cupola slag, which generally ranges between 4 and 9 per cent and points to the suggestion that the manganese has come from the metal. The 8.9 per cent alumina, 2 per cent lime and 11.25 per cent magnesia gives the impression that it has been obtained from a refractory.

It may be that oxidation during melting operation has some effect on the formation of this type inclusion, for of the 14 cupolas operating in the works in which the cited samples have been made, three are known to have a tendency toward excessive oxidation.

Chester H. Lang, formerly assistant manager, publicity department, and later comptroller of the budget, General Electric Co., Schenectady, has been appointed manager of publicity department succeeding Martin P. Rice, who retired Dec. 31, after more than 37 years of service with the company.

Prevent Losses With Proper Gates and Risers

By Pat Dwyer

IRON molds lend themselves readily to the production of nonferrous castings, and more particularly nonferrous metals with a particularly low melting point. Readers of early American history and fiction will recall that the bullet mold was an essential piece of household equipment and that every hero from Natty Bumpo to Daniel Boone carried a bullet mold in his pack when he fared forth into the wilderness to pit his wits and agility against those of four or two-legged *varmints*.

The mold was a comparatively simple contrivance, something like a nut cracker, hinged at one end in some instances equipped with a shears at the crotch for cutting the gate from the finished bullet. The essential features are shown in Fig. 134. Each mold was forged by hand, therefore at this late date in almost any collection, only rarely can two molds be found closely approximating each other in all particulars. Mass production and micrometers did not come in until bullet molds had passed out.

Lead castings are employed extensively in the textile industry on account of their high resistance to sulphuric acid and chlorine solutions commonly used in bleaching and finishing cloth. Problem of casting lead reels for pulling and transferring bleached cotton cloth through many operations in kiers, wash mills, acid squeezers and thence to the piling bins, has been greatly simplified by a southern foundry through adoption of a special cast iron mold in four parts, top, bottom and two side pieces for forming the groove.

For many years wood slats bolted to cast iron heads were used in the mills for pulling cloth. They still are used in some places. Rapid disintegration of wood, incident to alternate wet and dry conditions, has made this method expensive and as a result wood is passing out of the picture. The wood construction is replaced by a cast iron reel which in effect is a sheave with a V-groove. The castings are formed in halves, bolted together and placed on the shaft in any desired position. The cast iron hub is bored to fit the shaft and is attached by a set screw.

Cast iron yields rapidly to the attack of sulphuric acid and chlorine solutions. Corrosion and scale involve frequent replacement of parts. Brass has been tried and has served admirably for a longer period than iron, but eventually it also yields and presents a pitted and scaly appearance. This rough surface increases the wear on the cloth and introduces a tearing hazard. In the particular instance selected for illustration the problem was solved by casting the outside or rim of the casting in lead.

Make Bell Castings

SHEAVE wheel castings in halves that require neither shipping nor cleaning are produced in an iron mold made up of four parts, a bottom plate, a top plate and two semicircular side parts. Iron molds seem particularly adaptable to the production of nonferrous metal castings, particularly metals with a comparatively low melting point. Small bells, sleigh bells, hand bells, etc., are made in green sand molds and poured through gates on the top. Large bells are made in loam and dry sand molds, usually inside special cast iron flasks which conform closely to the shape of the bell. Sweeps are employed instead of patterns. Metal is poured from the ladle into a pouring basin which conducts it to the sprue or sprues on top of the casting.

Metal Attacked Core

In early trials the castings were made in a fine grade of Kentucky sand with a dry sand core to form the groove in the rim. The casting was poured as a unit, but was split. The outside of the casting came clean, but the metal seemed to soak into the core. A great deal of trouble was experienced in cleaning the groove without distorting the casting. Also, the first cores did not fit closely and the castings were disfigured by unsightly fins. Necessity of machining the groove increased the cost to a prohibitive point.

The present cast iron mold makes a perfect casting, which requires neither cleaning nor machine work. The mold is made up of four parts, top, bottom and two semicircular parts to form the groove in the lead casting. A seat machined on the bottom section accurately locates the two groove sections. A male and female joint and a dowel pin on the top, locate the cope section on the parts which form the groove in the casting, and on the bottom.

A thin steel strip placed in a slot in the drag and another similar strip located in like manner in the cope, serve to divide the mold into two parts and produce two separate half castings. The metal is poured from two ladles simultaneously into two vertical gates located diametrically opposite each other as shown in Fig. 135. Each gate ¼ x 2½-inches is tapered in such manner that the cope may be lifted from the casting.

Metal enters the mold at the highest part of the rim to facilitate the pouring at a comparatively low temperature. Various temperatures for melting and pouring were tried before a satisfactory standard was established. Satisfactory castings are poured with lead showing a temperature of 800 degrees Fahr., at the furnace and 650 degrees at the edge of the mold. Lead gates from previous castings are added to the metal in the ladles to reduce the temperature quickly. Several ⅛-inch vent holes through the cope allow the air to escape also serve to indicate that the mold is full.

Bells are molded and poured according to a variety of methods depending principally on the size of the casting. Probably the smallest is the sleigh bell which still is made in considerable numbers, despite the great changes that have taken place in methods of transportation. Viewed simply from a molding angle the production of sleigh bells presents no extraordinary features. The solid patterns are mounted in groups on follow-boards, in some instances as many as 50 patterns are mounted on the same board. In one typical in-

stance the 50 patterns are arranged in two groups of 25. Experience has shown that 25 is about the maximum number that can be filled from a single runner.

On account of pouring the bells in groups it is necessary to form the mold in a three-part flask, a drag containing the lower half of the mold impression, a cheek containing the upper half and also the gates and runner and a plain flat cope containing the sprue as shown in Fig. 136.

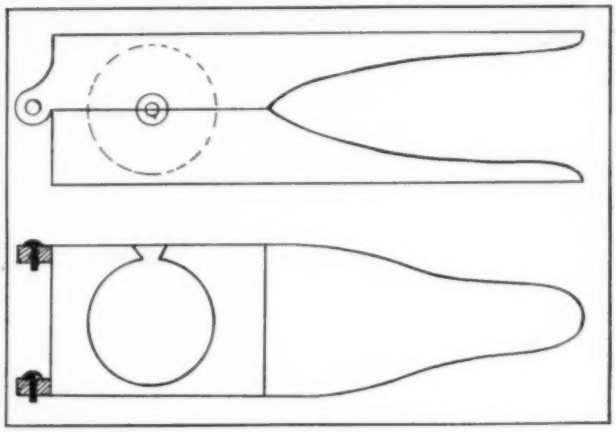


Fig. 134—Plan and Sectional View of Bullet Mold Used at a Period When Every Hunter Made His Own Ammunition

The follow board and flasks in one prominent foundry are wood, but that is in deference to age and custom. The patterns, coreboxes and gate equipment are metal, polished and finished to a high degree of accuracy. Guide pins are examined regularly and kept tight to prevent any shift between the flask parts.

Placed in Bell Core

Each little sleigh bell pattern is provided with a gap on the drag side and with three or four small indentations on the cope side. Sand which fills the gap on the bottom of the pattern serves later to support the dry sand core in the mold. The little mounds of sand formed by the indentations on the cope side of the pattern, serve as chaplets to hold the core in place when it is surrounded by metal.

The apparent mystery of a large ball or clapper inside a bell with a small opening is explained easily. The ball is bedded in the core. The core with the enclosed ball is dried and then placed in the mold. Later the sand is cleaned out through a thin slot in the bell casting while the ball remains on the inside.

To insure a perfect fit between the multiple gate and the group of patterns, the cheek is rammed first on the board with the patterns and gates arranged as shown in Fig. 136. Each bell pattern is independent of the others, but the metal device for forming the runners and gates is in one piece. A single member *A* extending across the entire group connects five bars that rest on the bell patterns through small, flat gates *C* that fork at the point where they touch the bell pattern. A small knob on top of the runner *A* serves as a guide in locating the single sprue in the cope.

The same general method is followed in making small hand bells and gongs. The patterns are mounted mouth down on the follow board. Since the castings are poured in the same position it is apparent that the cope is rammed first, followed by the drag. The entire mold is rolled over.

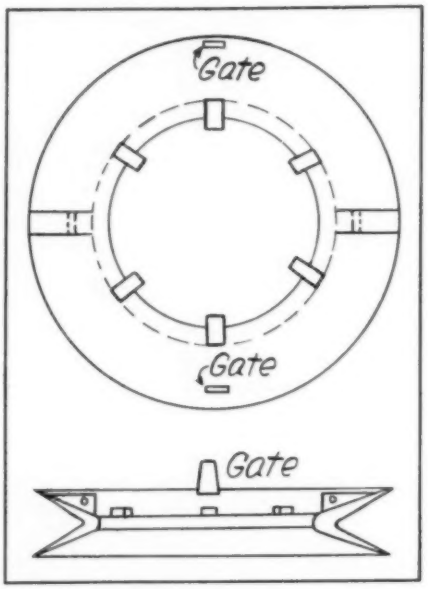


Fig. 135—Plan and Sectional View of Lead Sheave Cast in a Four-Part Iron Mold

The cope and drag are separated, patterns removed and the mold reassembled in the usual manner. The metal is poured through a small, flat gate on top. Variations and exceptions may be noted in the foregoing procedure. For example, some of the patterns are mounted in a manner to permit ramming the drag first. In all instances the patterns are exact duplicates of the castings and leave their own cores. The usual practice is to employ small, special flasks and to pour only one casting in a flask.

Locomotive bells and other miscellaneous bells smaller and larger sometimes are cast hub down, that is in the opposite position to the one they are destined to occupy in service, but the general practice is to cast them mouth down as shown in Fig. 137. In a good grade of sand bells up to 300 pounds may be molded in green sand. Between 300 and 500 pounds the molds should be made in dry sand or at least skin dried. Bells over 500 pounds in weight are made in dry sand or loam molds.

One of the main reasons for employing loam molds is that sweeps are employed instead of full patterns. The loam mold is strong and rigid and will yield a casting true to shape, size and metal thickness. These features are extremely important where the tone of a bell has to conform to a definite note in the musical scale. The same object is attained in smaller bells by forming the mold in a loam mixture inside a cast iron flask which conforms closely to the form of the bell. Extended descriptions of bell molding methods, materials and equipment have appeared in THE FOUNDRY on several occasions. Typical practice in an American foundry was illustrated in the March 15, 1921, issue. A comprehensive series of three articles on the practice in a British foundry was presented in the Nov. 15, Dec. 1 and Dec. 15, 1924, issues.

Poured at the Bottom

As with many other castings in ferrous and nonferrous metal, the logical place for the gate on a bell is on the top. With dry sand or loam molds this is quite feasible, but under certain conditions a top gate is not advisable on a large green sand mold. Where a doubt exists or where actual experience has shown that the sand will not withstand successfully the erosive action of the metal, the casting may be gated at the bottom in the manner shown in Fig. 137.

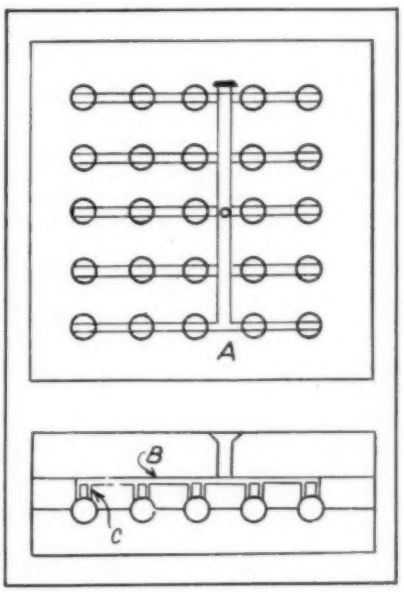


Fig. 136—Metal Is Distributed to 25 Sleigh Bell Molds Through a Series of Runners on Top of the First and Under the Second Cope

The principal hazard incident to this method is that the metal will wear away the sand forming the sprue opening and carry some of the slushy mess into the casting. Particular attention should be paid to ramming the sand around the sprue pattern. Sand that is too wet or too dry, or, patches of wet or dry sand, will yield either to the force or the temperature of the stream of metal. In this connection also it is pertinent to refer to a point considered in one of the early installments of this series. That is to the necessity of reinforcing the sand between the sprue and the mold cavity. If this is not done, and if the sprue is too close to the mold, the pressure of metal in the high sprue may cause the wall of the mold to cave in on that side.

Jog Breaks the Fall

In Fig. 137 it will be noted that the sprue contains a jog at the cope and cheek joint line. Also that the runner at the bottom extends past the group of branch gates. The jog is designed to arrest temporarily the abrupt fall of the first metal and thus reduce the speed. The extension in the runner is to catch and hold any foreign material that may descend the sprue with the metal.

The dry sand cap core shown in Fig. 138 is a precautionary device adopted with green sand bell cores, irrespective of whether the casting is gated at the top or the bottom. It is rammed up in the pattern and is anchored in place with three or four nails. Its principal purpose is to prevent steam from rising and escaping through the top of the core during the pouring period. Where the casting is poured at the top, this core withstands the fall of the metal more satisfactorily than green sand.

Instead of using a gate stick as in ordinary practice, the bell founder prefers to form his sprues in a dry sand or loam mixture. The block containing the sprue then is incorporated in that part of the mold above the crown or upper part of the bell. On large molds a basin is built from the edge of the cope to the sprue in the center. This feature does not differ from gray iron foundry practice and already has been covered in detail.

Since the pouring temperature affects the casting to a certain extent, it is advisable to explain that the metal should be poured at as low a temperature as possible. Naturally this temperature will vary to some extent depending on the thickness of the casting. This is one of the instances where no definite instruction can be laid down for pyrometrical reading or bell metal temperature. The technically trained man can adopt his own standard readings after a few trials. The practical man can judge the temperature by the color and by the relative brightness of the rainbow colors due to the tin content. These colors fade in conformity with the drop in temperature.

Many hazards incident to the production of castings may be foreseen in advance and proper measures taken to insure a safe passage. However, the element of chance never is absent and may cause an apparently perfect mold to turn out a defective casting. Relation of a typical instance may serve as a warning to those who have in the past or may have in the future occasion to use a reservoir runner basin formed in a dry sand core.

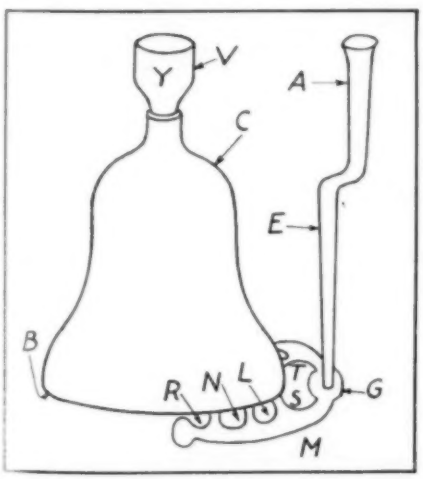


Fig. 137—*Metal Enters the Bell Mold Gently from the Bottom*

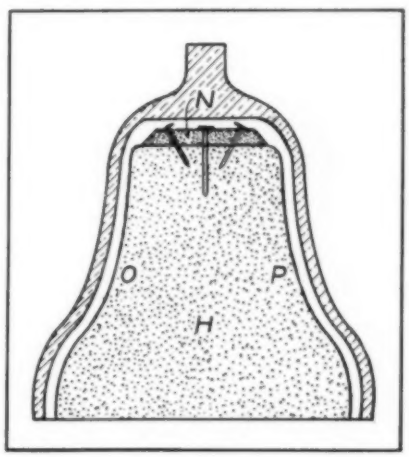


Fig. 138—*A Flat Dry Sand Core Is Nailed to the Top of the Green Sand Core*

A ladle containing 800 pounds of brass was brought to a mold fitted with one of these pouring basins. A stopper core was fitted in the opening in the bottom of the reservoir leading to the sprue in the cope. The intention was to fill the basin with metal, then remove the stopper core and thus insure the entrance of clean metal to the mold. The basin core was weighted on top and—as an extra precaution—was smeared with paste on the bottom, to prevent it from moving either up or sideways.

Unfortunately, the paste was smeared too generously and some of it worked up into the sprue opening in the bottom where it came into contact with the end of the stopper core. By the time the basin was filled with metal the heat had dried the paste and as a result the stopper core was anchored firmly. In an effort to loosen it by twisting, the end broke off and remained hopelessly in place.

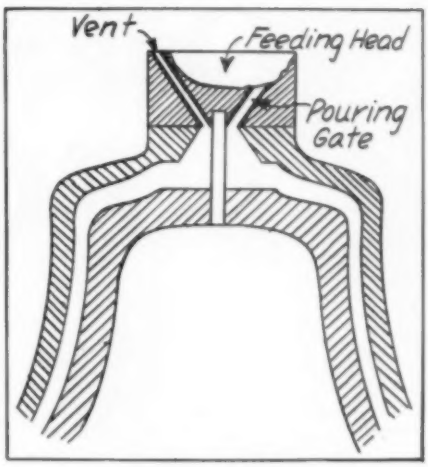


Fig. 139—*Metal from a Pouring Basin Enters the Mold Through One or More Pop Gates*

Finally, the runner basin was removed from the cope and the metal was spilled out. The broken plug was removed, another core fitted in place and the basin was replaced on the cope. In the excitement an attempt was made to pour the metal, but the delay had reduced the temperature to a point where the metal would not run readily and the casting was a waster.

This is the twenty-sixth of a series of articles dealing with the various types of gates and risers used in the foundry industry. The twenty-seventh installment will appear in an early issue.—THE EDITORS.

Who Should Lead?

(*Concluded from Page* 43)

the background. This is not compatible with a program economically planned.

At the beginning of the safety movement it was generally supposed that making a plant safe would slow up production to such an extent that there would be an economic loss; that goggles and other safety clothing, caution in the performance of the employe's work and other safety measures would slow up production and thus be less efficient than the original way with no accident prevention. Exactly the opposite has proved to be the case. The safe factory has proved to be the efficient factory. An efficient plant will always have a prescribed and successful safety program.

Efficiency in production, safety, health, and good morale are the elements necessary to have a perfectly functioning organization and should be encouraged in every way by management.

Questions & Answers on FOUNDRY PRACTICE

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall
Cast Steel

H. A. Schwartz
Malleable Cast Iron

J. W. Bolton
Gray Cast Iron

All questions must be addressed to the Editor, The Foundry, Penton Building, Cleveland.

GENERAL

Makes Plow Points

We are contemplating to enter the plow point making field on a large scale in our foundry, but before we start, we would like to obtain information on a mixture for tractor plow points.

The mixture used in making plow points varies from 90 per cent scrap and 10 per cent pig iron to 50 per cent of each. The analysis will range from 1.40 to 1.85 per cent silicon; 0.10 to 0.12 per cent sulphur; 0.50 to 0.75 per cent manganese; 0.25 to 0.40 per cent phosphorus, and 3.20 to 3.50 per cent total carbon. The heavier points of course, are made from iron with the lower silicon content. The metal poured into any particular type of points is determined by examination of chill blocks made from the ladle of hot metal. The iron should be poured at 2500 degrees Fahr. to obtain the desired chill, and eliminate a *snaky* surface appearance.

Plow point castings usually are made two in a flask, and an excellent description of the method may be found in the Nov. 1, 1920, issue of THE FOUNDRY. A stripping plate molding machine is used which makes the cope and drag at the same time. The molds are stacked and poured from a ladle which holds just enough metal. Raising the ladle from the bottom mold successively to the top mold is accomplished by a special pouring device.

Q & A

Facing Not to Blame

Will you kindly give us directions for preparing facing sand suitable for light ornamental gray iron castings requiring an exceptionally smooth surface free from cuts. These castings, from 1/8 to 3/16-inch thick, vary in size from 4 to 14 inches in diameter.

Facing sand in the usually accepted foundry sense of a mixure containing two or more varieties of sand, a certain amount of coal dust and a small amount of some artificial binding agent is not employed for the simple reason that it is not necessary on small, thin gray iron castings. A natural sand from the Albany district, readily available at reasonable cost from a sand supply company in your locality will serve your purpose without any special treatment or preparation outside the usual screening and addition of the proper amount of water. From your reference to cuts and a smooth face, we are inclined to the opinion that the manipulation of the sand, and not the sand itself, is to blame. If it is too dry, it will wash in front of the stream of iron. If it is too wet it will cut and scab through the action of the steam. Manifestly the maintenance of the correct amount of moisture is a factor that should be held under close control and not subject to the varying whims of many operators. Under certain conditions foundrymen find it advisable to sieve a light coating of exceedingly fine grain sand over the pattern, to be followed by ordinary sand from the heap.

STEEL

Steel Appears Dirty

We are manufacturing light and medium weight steel castings, ranging from a few ounces to 150 pounds in weight from metal melted in a special basic open-hearth furnace, and are encountering difficulties in obtaining perfectly clean castings when they are machined. Some contain little white spots of silica while others show larger spots in the form of slag. The steel ordinarily is poured at 3800 degrees Fahr. but owing to the spots of silica the temperature has been reduced to 3250 to 3300 degrees without much success, although the trouble is less pronounced. We have tried various sand mixtures, and pouring cups made of our regular dry sand mixture. The molds are made in green sand which are air dried. Those made just before pouring are sprayed with gasoline which is ignited to give a dry skin. A bottom pour ladle is used. The pouring cup is not covered with silica wash as it was thought that it caused the trouble. Would hand shanking be practical? Would a light silica wash spray help, and how should it be made? Can you give me any information on open and strong facing mixtures, and on core mixtures that will withstand washing? We tried a finer grade of silica sand in the facing but had pinholes. With Nos. 4 and 5 sand, and heap sand we obtained solid castings.

From the description of your trouble with steel castings it is difficult to form an opinion as to the source of the spots of silica which are found in the machined castings. It is possible, of course, that they may be due to careless ladle practice. If the temperatures given are correct, it would be

quite possible to pour the castings by hand shanking. However, this would depend upon the size of the heat, as it is difficult to dispose of large quantities of metal with hand shanks. It is hard to understand how slag spots in any considerable quantity could be found in the castings when a bottom-pour ladle is used. If these spots really are slag, it would indicate poor steel making practice which leaves the steel contaminated with slag inclusions. If these spots are not slag, they may be formed by the partial fusion of small portions of the sand from the mold, which would indicate that material of some sort is incorporated in the sand, giving it too low a melting point in some places.

It is seldom necessary or desirable to coat green sand molds with silica wash. Dry sand molds and cores should be coated with silica wash, which may be made by mixing silica flour with enough light core oil to give a thick slurry. We would not advise applying such a silica wash to geen sand molds.

A good strong facing mixture for green sand work can be made of 75 to 90 parts of washed silica sand, one part bentonite, and a small amount of one of the commercial pitch binders. It is preferable to use washed and sized silica sands in which at least 70 per cent of the sand will be found on not over three screens in the standard screening test.

A good mixture for a core which must withstand cutting and washing is 40 parts of sand, 2 parts silica flour, and one part of a good linseed-base core oil. The cores should be dried thoroughly, and washed with two or three coats of silica flour and linseed oil, drying each coat of wash as it is applied.

Finally, we might suggest trying an *acid* lining in the open hearth furnace instead of a basic lining, if a suitable supply of raw material and fuel is available in the locality.

Problems in Nonferrous Founding

By Charles Vickers

Molds Flanged Bushing

We would like to obtain information on the proper method of gating or heading a flanged bushing made in green sand. We make them flange up, and have tried gating on top of the flange and at the bottom of the casting without success. Can the bushing be made in metal molds?

The best way to mold heavy flanged bushings in green sand, according to experience gained in making thousands of the type used in steam railroad service, is to arrange the mold so that the flange is at the bottom. In other words, the casting cavity is entirely in the cheek with a flat drag and cover cope. The casting is gated at two points diametrically opposite from a single sprue not over 1 inch in diameter. The runner is cut in the drag, and the gates open into the flange.

The exact size of the sprue will have to be determined by experiment as it should be of a size that will feed metal to the cavity rapidly, but not so much so that it cannot be kept filled all the time. A riser should be placed at the top of the bushing extending through the cope. A dry sand core bonded with 1 part of fine flour to 20 parts of sharp sand gives good results although oil or other binders also may be used with success. The core should be made hollow with walls about 1-inch thick. After it is dried the interior is filled with molding sand by ramming it up in the pattern. Be sure to see that tht core is vented to the outside of the mold.

Bushings may be made in iron molds, and the methods used are described in two articles by Henri Marius which appeared in the Aug. 15, 1929, and Jan. 1, 1930, issues of THE FOUNDRY. In addition Mr. Marius presented a paper on that subject at the May, 1931, annual metting of the American Foundrymen's association held in Chicago. Methods of casting bushings in green sand are described in the Jan. 1 and Feb. 1, 1923, issues of THE FOUNDRY.

Q & A

May Remove Aluminum

We are having trouble with a large quantity of scrap gun metal and bronze which we purchased, and which contains a fair percentage of aluminum. Can you tell us whether a flux is manufactured, or suggest one that will remove the aluminum from the metal?

Removal of aluminum from the alloys mentioned is best accomplished by a secondary smelter who has the facilities and experience for conducting the operation. It usually is an oxidizing process. Cheetham described a method for removing small amounts of aluminum from an alloy containing 85 per cent copper, 4 per cent tin, 5 per cent zinc and 6 per cent lead in the Feb. 1, 1930, issue of THE FOUNDRY. The process consists of adding copper oxide to the molten metal. Copper oxide in the ratio of 1½ pounds to 100 pounds of metal was placed in a heated ladle, molten metal poured on it, and the mixture stirred well. The original metal contained about 1 ounce of aluminum per 100 pounds, and Cheetham stated that good castings were obtained after copper oxide treatment. Barium sulphate has been suggested as an effective means for removing aluminum from red metal, but the exact procedure for its use as yet has not been revealed.

Q & A

Pinholes Cause Trouble

I am operating a small brass and aluminum foundry and I am having difficulty due to the appearance of numerous pinholes in the aluminum castings after machining. I have tried the castings good and hot, and also a little cold, but that did not seem to make much difference.

Recent investigations by Hanson and Slater prove rather conclusively an idea that has been held by many for some time, that water vapor is the principal factor which causes pinholing in aluminum alloys. Water vapor and aluminum react at elevated temperatures to form nascent hydrogen which is absorbed by the aluminum, and causes the pinholes. The water vapor or rather the hydrogen from the water vapor may be absorbed mainly at two points. One is during melting, and the other in the mold.

If ordinary care is taken during melting to see that the temperature of the molten bath is not allowed to rise too high, and the metal is not allowed to stew at high temperatures for any length of time, trouble from pinholing usually can be reduced greatly. The metal should not be heated more than about 45 degrees Fahr. above the desired pouring temperature which is determined by experiment. A pyrometer is a piece of equipment that easily will pay for itself by permitting control melting and pouring temperatures.

In case the metal is overheated during melting, it is not the best practice to allow it to cool to the desired point and pour it into castings. Much grief may be prevented by removing the pot from the furnace, and allowing the metal to solidify. As soon as it has solidified throughout, place the pot back in the furnace, and bring it to the proper pouring temperature. That method usually called presolidification, allows the absorbed gases to escape without harm. The same occurs when the metal is poured into castings except that the pinholes are present.

The other point where water vapor may be absorbed to some extent is in a mold where too wet sand is used. However, in such cases blowholes also occur, although not always.

BILL

By Pat Dwyer

Claims the Cupola Should Be Slagged

BILL came in the other night, all a-twitter as the saying goes with some devilish scheme to upset my equanimity. I can tell in advance by the furtive glance, by the overstressed casualness, by the manner in which his hands stray into the pockets, that he is preparing to spring on me some fiendish device that will spoil my evening's rest.

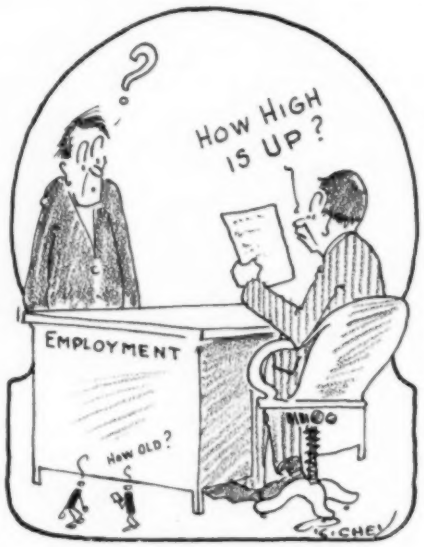
Sometime it is a far fetched theory to account for a natural or unnatural phenomenon. Again it may take the form of a mechanical puzzle acquired from a street fakir. Of course he is properly primed in advance and therefore takes great pleasure in my bungling and usually useless attempts to find a solution "Go ahead" I said on this occasion. "Spring it. I know you are mentally aching to spoil a quiet and peaceful evening."

"Well," said Bill "here's something to test your powers of observation, deduction, induction and whatever other factors usually are called into play in solving the mystery and determining who plugged the drain pipe from the kitchen sink in the typical thriller: *Big Dough the Dodo*, or *Nothing Left but the Crust.*

"The original copy brought to my attention carried an opening sentence to the effect that this intelligence test was developed by a certain prominent corporation to test the mental alertness of certain prospective employes. A maximum period of 2¾ hours was allowed the candidate to arrive at a solution. If he could not hand in a solution in that time he was given no further consideration."

"I am not in sympathy with that method of determining a man's fitness for a job" I said "or in fact with the usual type of questionnaire presented to applicants for anything from a job, to permission to enter an institution for a course of study. The applicant may be clever and smart, easily adaptable and of the type that absorbs knowledge easily, but because he cannot supply the answers to a series of trick questions, he is turned down. As the memory is developed, the reasoning power decreases and that is a calamity.

"Useful facts of all kinds are available in printed form. Any person can consult them almost at any time and in any place. The ability to reason from cause to effect, to discriminate, to separate the true from the false, in a word, the ability to think in logical sequence is a faculty which has to be developed by constant practice. A man's proficiency can not be measured by his response or lack of response to such trick questions as: In what years did Henry II reign in England? Who was vice president of the United States in the Roosevelt administration? What is the difference between syntax and the income tax?"



Getting a Job Seems To Present More Difficulty Than Holding It

"I get you" Bill hastened to assure me "you are absolutely right and I am quite gratified to find that I am in hearty accord with such noble sentiments. However, this little test which I now am about to lay before you contains no trick question. There is no catch to it. Every item is relevant and must be taken in consideration. In other words, dear lad, it is a highly involved, highly tricky combination of words designed to test your reasoning faculty. You will be surprised to find how many false trails will lead you astray. You will have your finger on the solution half a dozen times only to have it disappear like the tail of an eel. 'Ha-ha,' you will say to yourself, 'I have identified No. 1 and No. 2. Now to settle No. 3 in his proper niche.' Then as through a glass darkly, you will discover that in some mysterious manner No. 1 has become No. 2 and No. 3 may be substituted for either.

"In some respects the problem is reminiscent of the famous 'How old is Ann?' which had every person over 10 biting their nails and developing insomnia twenty odd years ago. However, there is this main difference. Ann's age still is unknown, but the present problem is not beyond the capacity of any ordinarily intelligent person."

"All right," I said, assuming as nearly as possible the attitude and accent of Seth, the honest farmer boy about to try a verbal tilt with the city slicker. "Let 'er flicker!"

"Flicker is good. I bet your little weasel eyes will flicker before you settle the identity of the three lads in this puzzle."

"Why the eyes? Is this one of these puzzles made up of impossible combinations of bent wire?"

"No," Bill said "It is not as simple as one of those wire contraptions that can be locked or taken apart with the greatest ease by a man who has the combination, but which is a hopeless mess in the hands of a man without this priceless information. This puzzle I am telling you about is too involved to present orally. You will have to write it down. Then with the copy constantly in front of you, you can concentrate on the solution. Get a pencil and paper. On your marks! Get set! Go!

A train is operated by three men—Smith, Robinson and Jones. They are fireman, brakeman and engineer, but not respectively. That is any of these men may hold any of these jobs so far as you know at present. Three business men are traveling on the same train. Singularly enough their names are the same as those of the crew. To distinguish them from the lowly sons of toil and incidentally help you work this puzzle, we shall call them Mr. Smith, Mr. Robinson and Mr. Jones. All clear so far? Well, then set down the following data:

1—Mr. Robinson lives in Detroit.

2—The brakeman lives halfway between Detroit and Chicago.

3—Mr. Jones earns exactly $5000 per year.

4—Smith beat the fireman at billiards.

5—The brakeman's nearest neighbor, one of the passengers, earns exactly three times as much money as the brakeman earns when he works.

6—The passenger whose name is the same as that of the brakeman lives in Chicago.

Question: Who is the engineer?

"Of course" Bill explained "the question really is more inclusive than would appear on the surface. In the process of unscrambling the puzzle, the identity of the brakeman and fireman come to light as well as that of the engineer. Well, there it is, my lad. It is all your's. Now see what you can make of it."

I wrestled valiantly with the thing, but as Bill had prophesied, the clues either slipped through my fingers, or led me into cul-de-sacs from which I had to retreat and cast about for a new trail. Bill watched me for a while in amused toleration and then volunteered the solution.

"No use wasting any more time over it" he said "If you can't hit it the first 5 or 10 minutes, you might just as well give it up. Here, listen closely and I'll show you how to find the answer.

"Start with item 4—Smith beat the fireman at billiards. Billiards, of course is mere camouflage. The essential feature is that the fireman's name is *not* Smith. Therefore Smith is the name of either the engineer or the brakeman.

"Item 5—The brakeman's nearest neighbor earns a salary divisible by 3. The salary of Mr. Jones, $5000 is not divisible by 3, therefore the brakeman's nearest neighbor must be either Mr. Smith or Mr. Robinson. It cannot be Mr. Robinson, because Mr. Robinson lives in Detroit, an equal distance from the brakeman and his namesake.

"With Mr. Smith established as the name of the passenger with an income divisible by 3 and as the nearest neighbor of the brakeman, and with Mr. Robinson definitely established in Detroit, it is apparent that Mr. Jones is the passenger from Chicago. I trust that is clear. Hey?

"With these facts established the remainder is simple. Jones, the namesake of Mr. Jones is the brakeman. Smith is either the brakeman or the engineer. According to the preceding sentence, Jones is the brakeman, therefore Smith is the engineer. Since there is only one name and one position left, Robinson automatically is located as the fireman.

"Simple, hey? Well" said Bill "I'll tell you. Problems are old stuff in the foundry. I had an inquiry recently from a man who has a cupola lined to 44 inches and provided with six 6-inch tuyeres equally spaced around the circumference. These tuyeres are about 9 inches above the sand bottom. The usual melt was from 10,000 to 12,000 pounds per heat and he experienced no trouble. Recently he enlarged the foundry and now is melting from 21,000 to 22,000 pounds per heat and experiencing considerable trouble through the coke and iron bridging above the tuyeres. Also the bottom does not drop clean. He operates a stove plate foundry where the iron runs constantly. He uses 1200 pounds of coke on the bed and 160 pounds between 1500-pound charges of iron. At present the heat extends over a period of 2½ hours. The cupola delivers satisfactory iron over the first half of the heat but during the second part of the heat the iron melts slowly. The cupola is not equipped with a slag spout and no flux is used. The melting line shows about 24 inches above the sand bottom.

"To maintain an even melting speed with a cupola running over an hour the charge must be fluxed and the slag drawn off through a suitable sag opening preferably at the back 3 or 4 inches below the lower edge and between two tuyeres. The greater part of the coke is consumed but a considerable amount of ash is produced over a long heat which must be removed to keep the furnace clean. The flux unites with the ash to make a liquid slag, the most convenient form in which it may be removed.

"A 6-inch opening easily may be cut through the shell either with an oxyacetylene torch or with an ordinary hammer and cape chisel. A few bricks may be removed from the lining and an opening somewhat similar to the tap hole prepared with clay and brick bats. The opening usually is stopped with clay until the heat has been running from ½ to ¾ of an hour. Then it is opened and the accumulated slag runs out. However in many instances the hole is not stopped but remains open from the beginning to the end of the heat.

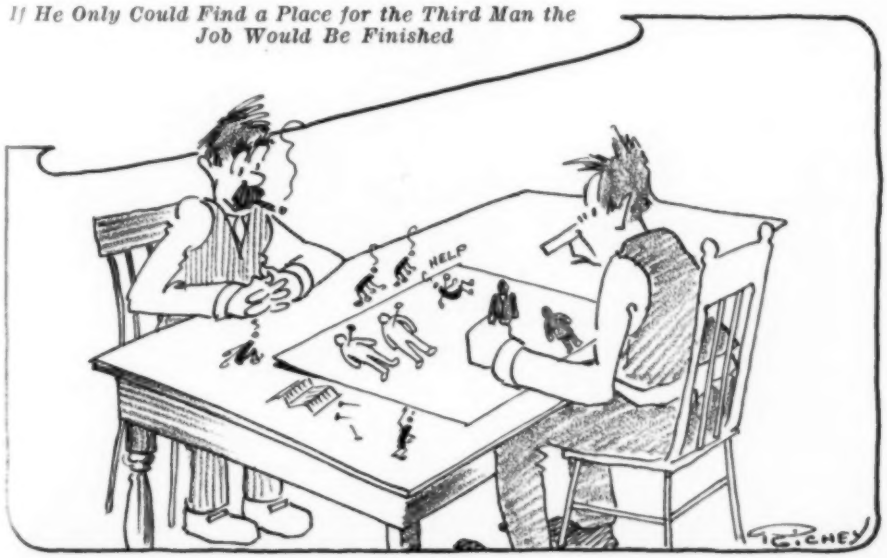
They Won't Stand Still Long Enough To Be Identified

"The volume of air that blows through the slag hole usually is negligible and does not affect the speed of melting to any extent. To obtain the most satisfactory results in his case where the metal runs in a constant stream from the cupola, a well of metal should be held in the cupola, approximately 1 or 2 inches below the slag hole. In this manner the slag collects at the proper level and flows constantly through the slag hole as it accumulates.

"Several suitable fluxes are on the market. He can secure the address of the manufacturers and other necessary information by consulting the advertising pages of THE FOUNDRY.

"The present coke to iron ratio corresponds to good melting practice. A 44-inch diameter cupola designed and operated properly should melt approximately 7 tons of iron per hour. If he does not attain this speed I suggested he rearrange the tuyeres and blowing equipment. He will require a blower capable of delivering 3500 cubic feet of air per minute at from 8 to 10 ounces pressure—high enough in this instance."

If He Only Could Find a Place for the Third Man the Job Would Be Finished



BLITHELY He Starts Second HALF CENTURY

Photo Bachrach

WHEN he is not away duck hunting in the fall of the year, John Harsch, *haid* man at the plant of the John Harsch Bronze & Foundry Co. may be found any day busily engaged in conducting an extensive business at the same plant located on the right hand, or north side of Madison avenue a short distance west of where the New York Central railroad tracks cross that well known thoroughfare in the city of Cleveland, O.

Busily engaged in this particular instance means a great deal more than usually is implied by one of the most elastic statements in this or any other language. A brave statement to make in view of the current depression and one thing and another, but John is an exceptional person, one of the comparatively small number of the Benvenuto Celleni school of foundrymen, capable of turning his hand to anything and everything in the production of a casting, from laying out the design on a drawing board to selling the finished article—at a profit.

A true artist, he derives special pleasure in the production of castings that present difficult features either in the manipulation of the mold or in physical properties of the metal. Skilled men in his employ yield with deference to, and appreciate the touch of, the old master. He specializes in architectural, ornamental and statuary castings in all the nonferrous metals. Examples of his work are scattered all over the United States.

John was born in Chicago a short time before the famous fire from which all subsequent city history is reckoned. It is barely possible—though scarcely probable— that a few people never heard of this memorable event. For their benefit, additional information is presented to the effect that our hero was born shortly after the close of the Civil war. Horoscopers—should that be horoscopists? — horoscopers, astrologers, fortune tellers (card, palm or tea leaves) and other grave and learned men and women probably can trace John's duck hunting proclivities to an early environment of war and fire.

Maybe so, maybe so. John never has wasted any time speculating on the possible or probable cause. He likes to knock 'em over, pintail, mallard, teal or redhead, as they whiz up like rockets against the wind. He likes the smell of the marsh. He likes to see the first rays of the sun quivering among the reeds. He likes the tired feeling and that hunger that follows a day among the blinds. Incidentally it may not be out of place to remark that he likes a roast duck. He holds definite views on how these noble birds should be shot, and even more definite views —if that is possible—on how they should be cooked.

All of which is getting away from the subject of the foundry and of John's intimate connection with it for a period of 50 years. He cheerfully admits that the first 50 years have been the hardest and that the coming 50 promise a measure of respite now and again—particularly in the hunting season—from the exacting cares of an extensive business. For the past several years two sons have lined up, one on either side, one in the shop and one in the office and have assumed a goodly share of the cares and responsibilities.

The foundry tradition kind of runs in the family. John's father was a molder and at an early stage in the boy's career decided that his son might do worse than follow in his footsteps. To that end he had him apprenticed to learn the art and science of casting and founding in metals at the plant of the Reedy Elevator Co.

According to modern ideas and standards a boy is supposed to finish a course in high school before he ventures forth to accept a position. If he is smart, as smartness is measured in the schools, he may be allowed to go at 16. Usually—what with social and athletic activities to interrupt his studies— he is nearer 18 than 16 when he goes forth to offer the priceless boon of his service to a waiting world.

These conditions did not obtain when John was a boy. In those days schooling was only incidental and the school a place to be abandoned at the first inkling of a job. A grand place for small children and a handy place for larger boys to idle away time that could not be exchanged for coin of the realm. At the age of 13 John had his last glimpse of the inside of a school room, but in later years he found that a considerable degree of knowledge, various kinds of knowledge, may be acquired even outside of school rooms, by a student diligently inclined.

This desire for knowledge took him for varying periods into several foundries where he discovered that a different technique is required on each class of casting. He made big ones and little ones in gray iron. He made stoveplate castings. He worked in a steel foundry, one of the first in the middle west. He made ornamental castings and statuary in all the 57 varieties of nonferrous metal and then with this background of knowledge and experience he took charge of Winslow's foundry in Chicago, a foundry which specialized in the production of castings for architectural purposes.

(*Concluded on Page* 61)

The FOUNDRY Family Photograph Album

Upper Left

VICTOR STOBIE
Oakfield, Ryton-on-Tyne, England

Upper Right

FREDERICK FAY
Finch Mfg. Co., Scranton, Pa.

Lower Left

R. L. RICKWOOD
Worthington Pump & Machinery Corp., Cincinnati

Lower Right

PAUL D. MERICA
International Nickel Co., New York

DAN M. AVEY
Editor

The Shakeout

FRANK G. STEINEBACH
Managing Editor

PAT DWYER
Engineering Editor

EDWIN BREMER
Metallurgical Editor

CHARLES VICKERS
Nonferrous Editor

NORMAN F. HINDLE
Assistant Editor

¶ Seize Every Advantage

THESE days alert foundrymen are not overlooking any bets whereby expenses can be whittled down to the irreducible minimum. A small amount saved here and a small amount there, even if only in the decimal parts of a cent, means a worthwhile overall saving. It is not difficult to find places where dollars may be saved. The difficulty lies in accounting for the fractions of a cent, for like the pinhole in the tire, it first must be discovered before it may be repaired.

DISCOVERY of the places to make small savings cannot be accomplished by hooking the heels on the edge of the desk and getting a faraway look in the eyes. It means a careful scrutinizing and analysis of every factor that enters into the production of castings from the raw material to the shipment of the finished product. Skimping on the quality of castings is not saving for its repercussion will be the loss of part or all of the customers. Search into every possible nook and cranny may yield surprising results, even to those who believe that they are beyond that stage. In past years many extravagances, some minor, some major, have crept into existence. Scrutiny will disclose them as the little foxes that eat the grapes of profit.

IN THE search for ways and means to cut down production costs, many foundrymen who use electric melting furnaces are taking advantage of the decreased demand rate offered by the utility companies for operation during certain periods of the night when demand for power ordinarily is at a low point. The concession offered undoubtedly is worthwhile because more and more electric steel, gray iron and nonferrous foundries are turning to night operation. The possibility of reducing melting costs is worth looking into, and may mean the difference between profit and loss.

¶ Index Is Ready

AN INDEX of all articles published in THE FOUNDRY during 1931, giving complete reference and cross-references to the material which has appeared in each of the 24 issues, has been prepared for distribution. Readers who bind or preserve the past issues of this publication will find the index of value in referring to articles which have been published. A copy of the index will be mailed free of charge to any reader who requests it from THE FOUNDRY, Circulation Department, Penton Building, Cleveland.

¶ Babbitt Is Best

WITH characteristic modesty and self effacement, nonferrous foundrymen, particularly those engaged in the production of bearings for rolling mills and other places where the service is unusually severe, probably will neglect to capitalize on the contributions to a symposium on mill bearings held at a recent meeting of the American Society of Mechanical Engineers in New York. Had the verdict been reversed they probably still would have remained silent, or at best would have shrugged their shoulders and accepted the verdict as something ordained by fate and therefore unescapable. This form of inertia is a hangover from a former day when foundrymen had a waiting list of customers and where the loss of one or two was not noticed.

IN THE symposium, one speaker said that he had experimented with lignum-vitae bearings in certain places where the load was heavy, the service unusally severe, and where formerly he always had employed babbitted bearings. After three months operation and the production of 6000 tons of rolled material, he found that the lignum-vitae bearings were completely worn out, while babbitted bearings under a similar test still retained considerable life. Had the result hinged on this factor alone, he might have pursued the experiment, at least to the extent of a second trial, but when he found that the cost of the lignum-vitae bearings was ten times that of the babitted bearings, he decided no farther experimenting was necessary.

UNDER present conditions and probably for some time in the future, rolling mill operators and other users of machinery will be in an experimental mood, eager to try anything that is recommended to reduce the cost of operation. Foundrymen can do themselves and their customers a service by familiarizing themselves with the particulars of experiments that failed, where other materials were substituted for castings. Facts and figures are more potent arguments than "I guess not" or "I don't think so."

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

E. E. GRIEST, recently elected president, Malleable Iron Research institute, is vice president in charge of manufacture of the Chicago Railway Equipment Co., which includes manufacturing plants at Chicago, and Franklin, Pa., the Franklin Steel Works, Franklin, Pa., the Marion Malleable Iron Works, Marion, Ind., and the Grand Rapids Malleable Iron Works, Grand Rapids, Mich. Mr. Griest was born at Zanesville, O., in 1882. He served as a machinist apprentice, Pennsylvania railroad, Columbus, O., from 1900-1904, and then entered the school of mechanical engineering, Purdue university, Lafayette, Ind. After graduating in 1907 he became designing engineer, Crucible Steel Co., of America, Pittsburgh and in October of the same year he was made machine shop foreman, Erie railroad, Hornell, N. Y. In 1908 he was appointed assistant general foreman, Pennsylvania railroad shops, Fort Wayne, Ind., later being advanced to assistant master mechanic and in 1915, master mechanic. In 1918 he became connected with the Chicago Railway Equipment Co., Chicago, as assistant general superintendent and in 1919 he was promoted to general superintendent, serving in that capacity until June 15, 1931 when he was made vice president in charge of manufacture. Mr. Griest is a member of the American Foundrymen's association, American Society of Mechanical Engineers, American Society for Testing Materials, Western Society of Engineers, Western Railway club and the Chicago Foundrymen's club. He has contributed a number of papers to the technical and business press and before various engineering societies.

Everett D. Betts, formerly superintendent, Ideal Furnace Co., Milan, Mich., has organized and heads a new company, the Betts & Cole Heater Co., Marshall, Mich.

George Vail, vice president, Ohio Steel Foundry Co., Lima, O., and for several years in charge of the Cleveland district of the company, has retired from that organization.

Jack Asplan is superintendent of the Kalamazoo Stove Co., Kalamazoo, Mich., during a leave of absence which has been granted **Harry Wolverton. H. C. Buechner** is purchasing agent of the company.

William L. Heppner, Cleveland, has been named foundry supervisor and sales representative, Banner Machine Co. plant, Columbiana, O., by the National Rubber Machinery Co., Akron, O. Mr. Heppner was formerly with C. C. Kawin, Chicago, as foundry advisor and more recently with the Euclid Foundry Co., Cleveland, as foundry superintendent and sales representative.

Boniface A. Miller, formerly metallurgist, Bartlett Hayward Co., and American Hammered Piston Ring Co., Baltimore, has been made metallurgical engineer, James J. Lacy Co., Baltimore.

E. E. Griest

Charles P. Whitehead, formerly sales assistant to the vice president and general manager, Commonwealth division, General Steel Castings Corp., Philadelphia, has been appointed manager of sales with general supervision of the entire sales organization.

George B. Limbert now is foundry superintendent, Western Gas Construction Co., Ft. Wayne, Ind., a subsidiary of Bartlett & Hayward Co., Baltimore. The Ft. Wayne foundry is devoted to heavy castings, specializing in equipment for the gas industry.

Thomas F. Maher, formerly vice president and sales manager, Chapman Valve Mfg. Co., Indian Orchard, Mass., has been made president, succeeding **Adolph W. Gilbert**, recently resigned after serving for more than 20 years as the head of that company.

George B. Pickop, assistant superintendent Malleable Iron Fittings Co., Branford, Conn., left Jan. 8, on a combined pleasure and business trip that will extend over 3 months. He will remain at Daytona Beach, Florida, until March 1 and then drive through to Los Angeles. The return trip will be made through the states lying north and east of Texas. He expects to arrive home about April 1.

Irwin E. Stephens, formerly foundry foreman, has been appointed foundry superintendent, Advance Foundry Co., Dayton, O. Mr. Stephens was born in Dayton in 1885 and began his career in 1901 with the Platt Iron Works of that city. He served his apprenticeship with that company and rose to the position of foundry superintendent. He remained with that company for 15 years and then entered the employ of the Advance company.

New England Founders Elect Officers

Election of officers featured the annual meeting of the New England Foundrymen's association which was held at the Engineers club, Boston, on Jan. 13.

New officers are as follows: LeRoy M. Sherwin, Brown & Sharpe Mfg. Co., Providence, R. I., president; Albert Sweet, Milford Iron Foundry, Milford, Mass., vice president; George H. Gibby, Gibby Foundry Co., East Boston, Mass., treasurer; Fred F. Stockwell, Barbour-Stockwell Co., Cambridge, Mass., secretary. The executive committee is as follows: Fred D. Shaw, Walker-Pratt Mfg. Co., Watertown, Mass.; Ralph R. Meigs, General Electric Co., Everett, Mass.; George W. Thornburg, Crescent Park Brass Foundry, Waltham, Mass; Alexander S. Wright, Hunt-Spiller Mfg. Corp., Boston; and Charles A. Reed, Rogers, Brown-Lavino Co., Boston.

Following the election, President Sherwin spoke briefly on the splendid attendance and the interesting topics which featured the meetings during the past year. The next meeting will be addressed by E. H. Ballard, president, American Foundrymen's association, and the March meeting will be arranged by the brass foundry members of the association. In addition, a round table talk on an iron foundry subject will be included at the March meeting. Regular meetings are held the second Wednesday of the month.

The remainder of the evening was devoted to a special entertainment provided by the committee. Approximately 70 members were present.

OBITUARY

Oliver Stubbs, past president of the Institute of British Foundrymen and formerly joint managing director of Joseph Stubbs, Ltd., Manchester, England, manufacturer of textile machinery and castings, died Jan. 4. During his term as president of the British foundry association, Mr. Stubbs, with the late Thomas J. Firth, Brightside Foundry & Engineering Co., Sheffield, was one of the pioneers in establishing the cordial relationship between British and American foundry organizations when he made an official visit to the United States in 1922. Prior to his retirement from business life in 1929 Mr. Stubbs was active in the National Ironfounders Employers' federation and a member of the council of the British Cast Iron Research association.

Alonzo Aldrich, 72, president of the Beloit Iron Works, Beloit, Wis., died at Cleveland, recently.

William A. Young, for 20 years associated with the Harnischfeger Corp., Milwaukee, as chief and consulting engineer, died Dec. 23 at the age of 61.

William D. Pomeroy, 57, vice president and general manager of Gould Pumps Inc., Seneca Falls, N. Y., died Jan. 6 at Seneca Falls.

Nathan M. Carl, vice president of the Buckeye Brass & Mfg. Co., Cleveland, died at his home in that city Jan. 14 after a long illness. He was 44 years old.

George H. Thompson, 63, president, Columbus Malleable Iron Co., Columbus, O., died at his home Jan. 11. Mr. Thompson was associated with the malleable company since it was moved to Columbus from Hoosick Falls, N. Y., 21 years ago.

Fred Hoffman, 60, president, Hoffman & Billings Mfg. Co., Milwaukee, manufacturer of plumbing fixtures, died Jan. 1. He was born in Milwaukee and as a youth became identified with the company, founded by his father in 1857. Upon his father's death in 1894 he became president of the company.

George S. Sinclair, pioneer foundryman in Grey and Bruce counties, Ontario, died at Owen Sound recently, aged 84 years. He conducted the Sinclair Vulcan Foundry at Wiarton and also the Robinson & Sinclair Foundry at Wingham. He served the town of Wiarton in several civic capacities, and was mayor of the municipality in 1903 and 1904.

Harry W. Feldhaus, foundry superintendent, Advance Foundry Co. Dayton, O., died recently. He had been connected with the Advance company for 7 years. Mr. Feldhaus was born in Dayton on Aug. 6, 1881, and received his education in the public schools of that city. He began his foundry career as an apprentice with the Buckeye Iron & Brass Works, Dayton, when he was 15 years old. He remained with that company until 1925 when he became foundry superintendent of the Advance company.

Knowlton L. Ames Sr., 62, Chicago, chairman of the finance committee of the Murray Corp. of America, Detroit, director of American Steel Foundries, and chairman of the board of Booth Fisheries Co., Chicago, died recently. Mr. Ames formerly was active in the development of the Griffin Wheel Co., Chicago, later acquired by American Steel Foundries.

DeWitt F. Riess, vice president of

Oliver Stubbs

the Vollrath Co., Sheboygan, Wis., died of a heart attack in Chicago recently while attending the annual sales conference of the company. He was the son of the late John R. Riess, who was secretary and treasurer of the Vollrath company, a pioneer manufacturer of enameled steel and cast iron wares.

Jordon Lawrence Mott, 76, son of the founder of the Jordon L. Mott Iron Works Inc., and former president of the company, died Jan. 6, at Nelson harbor, Bahamas, B. W. I. After completing his education he entered the employ of the Mott Iron Works and after the death of his father in 1915 served as president until his retirement several years ago.

J. T. Moltrup, 61, president of the Moltrup Steel Products Co., Beaver Falls, Pa., died Jan. 13 at his home. Mr. Moltrup helped to organize the Standard Gage Steel Co. at Beaver Falls which later was merged with the Union Drawn Steel Co., now a part of the Republic Steel Corp. In 1914 Mr. Moltrup with his brother, the late Stephen Moltrup, founded the Moltrup Steel Products Co., producer of cold drawn steel, shafting and foundry flask plates.

Donald Fraser, director and former vice president, Chain Belt Co., Milwaukee, died recently. Mr. Fraser, early engaged in the pattern-making business in Minnapolis and Milwaukee, became connected with the Chain Belt Co., in 1895. Subsequently he became vice president and works manager, and retired in 1917 to become a director of the company. He also was a director of the Sivyer Steel Casting Co., and the Federal Malleable Co., both of Milwaukee.

Salvage Scrap Metal from Ashes

Savings of approximately $16,000 a year are realized from salvaging metals from ashes produced in the scrap incinerator at the Schenectady plant of the General Electric Co. The ashes, instead of being loaded into a dump car and delivered to the dump, first are run through a ball mill, where they are pulverized. The larger pieces of metal pass out of the mill and over a magnetic separator, which separates the magnetic scrap from the nonmagnetic material.

The finer material discharged from the ball mill passes over an inclined, longitudinally grooved concentrating table, which has a stream of water flowing crosswise of the material. The metal being heavier than the ash, slides down the bottoms of the grooves and falls off the lower end of the table, while the ash is washed off the side of the table and then is pumped through a dewatering cone which discharges the dewatered ash in a dump car. The ash is used for filling in low ground and the metals and concentrates are sent to the smelter or sold as scrap.

By this method approximately 100,000 pounds of ashes are ground and washed and from 20,000 to 25,000 pounds of metals and high grade smelting material are recovered each month.

Opens American Office

R. Fuess, Berlin-Steglitz, Germany, manufacturer of instruments for scientific, research, and industrial control has established an American office as R. Fuess Inc., 245 West 55 th street, New York, in charge of Lewis Muscat. The firm manufactures apparatus for crystallography, microscopy, spectroanalysis, measurement of the flow and pressure of gases, fluids and liquids, temperature indicating and recording, etc.

Eugene Smith Is Dead

Eugene W. Smith, age 73, veteran Chicago foundryman and general superintendent of iron and steel foundries of the Crane Co., Chicago, also with jurisdiction over the company's foundries at Bridgeport, Conn., Birmingham, Ala., Montreal, Canada, and Chattanooga, Tenn., died Jan. 19 at his home in Oak Park, Ill., after a short illness. He was the second oldest living employe of that company, having been identified with the Crane company foundries for nearly 60 years, for many years as foreman of the company's Chicago foundries. He entered the employ of the company as an apprentice in the malleable foundry at 14.

Eugene W. Smith

Mr. Smith had specialized in several branches of the foundry industry, particularly in molding sands, on which he wrote a number of technical articles and pamphlets. He was the author of a book, "Foundry Sand, Its Uses and Abuses," published in 1926. At a laboratory in his home, he had collected samples of all known molding sands throughout the world, and had an interesting display of many varieties at the A. F. A. convention in Chicago last year. Mr. Smith also had invented a vibrating system for testing sand by a separation of the clay and silica contents. He had made arrangements for the eventual custody of his sand collection by the Rosenwald museum of science and industry at Chicago.

Mr. Smith had been president of the Crane Veterans' league for many years and president at one time of the Western Foundrymen's association. He was a member of the American Foundrymen's association, Chicago Foundrymen's club, and several other organizations. His son, Eugene W. Smith Jr., is the head of a molding sand company with headquarters at Evansville, Ind.

Plan Heating Conference

Tentative arrangements have been made for the Process Heating conference in Cleveland on Feb. 10, 11 and 12, the second of a series of three planned by Case School of Applied Science in conjunction with the Cleveland Engineering society. Dr. W. R. Veazey, head of the chemical engineering department at Case is general chairman of the conference.

All of the sessions will be held in the Electrical building on the Case campus. The real purpose of the industrial conferences is to aid the graduate engineer in "brushing up," so to speak, on the changes which are recurrent in his particular field.

Among the dicussions of interest to the foundry field are the following: "Refractories: Present Types, Uses and Unit Costs," by O. L. Day, Harbison-Walker Refractories Co., Pittsburgh; "Refractories: Research Problems and Future Needs;" "Heat Insulation Materials for Industrial Furnaces," by J. W. Blemker, Johns-Manville Co., Cleveland; "Most Recent Trends in Industrial Oil-Fired Furnaces;" "Future Possibilities of Gas Utilization in Industrial Processes."

"The Application of Small Electrical Heating Units;" "Induction Furnace" by Frank T. Chestnut, Ajax Electrothermic Corp., Trenton, N. J.; "Electric Arc Furnaces" by Samuel Arnold 3rd, American Bridge Co., Ambridge, Pa.; "Control of Atmosphere in Electric Furnaces," by H. J. Babcock, General Electric Co., Schenectady, N. Y.; "The Economics of Electric Furnace vs. Fuel Furnaces," by Wirt S. Scott, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; "Problems Involved in the Use and Production of Powdered Coal for Process Heating," by C. R. McClure, Babcock & Wilcox Co.

Publishes Abstracts

The engineering experiment station, Ohio State university, Columbus, O., has published a booklet entitled "A Resume of Published Data on Steel Foundry Practice," by A. H. Dierker and H. B. Kinnear. The booklet contains 56 pages devoted to short abstracts of steel foundry literature appearing in various journals dealing with the field.

The abstracts were prepared in cooperation with the American Foundrymen's association. Copies of the booklet may be obtained from the experiment station for $1 each.

E. A. Custer Jr. Is Dead

Edgard A. Custer Jr., 45, widely known as a consulting foundry engineer, died at his home in Philadelphia Jan. 2. Mr. Custer graduated with the 1908 mechanical engineering class of the University of Pennsylvania. During his vacations he worked with his father at the Tacony Iron Works, at the period when Mr. Custer Sr. was carrying on his famous experiments with permanent molds. To him is given the credit for much of the technical research inevitable in any pioneering field. After graduation he was appointed superintendent of the foundry and later made superintendent of the plant. In 1913 he became foundry superintendent of the Enterprise Mfg. Co., and left there to become superintendent of machining at the Frankford Arsenal. At the close of the war he went to Augusta, Ga., as civilian superintendent to the commanding officer of the arsenal there. In 1920 he resigned to take up consulting work exclusively, particularly in the foundry field. A remarkably original paper, "An Engineer Visualizes Foundries of the Future," was presented by Mr. Custer through the columns of THE FOUNDRY in the Oct. 15 and Nov. 1, 1927, issues.

E. A. Custer Jr.

To Sell Recorders

Harry W. Dietert Co., 676 W. Grand boulevard, Detroit, has secured the rights from the United States Radiator Corp., Detroit, to manufacture and sell the special cupola iron temperature recorder which now is in use in all of the foundries of that corporation. It is claimed that the molten iron temperature may be controlled readily with the aid of this recorder since each of the many possible improper cupola operations is recorded by a rise or dip in the temperature curve. This makes it possible to determine the particular faulty operation.

Discusses Conveyors

H. L. Hoefman, engineer, Link-Belt Co., Chicago, addressed the regular monthly meeting of the Detroit Foundrymen's association held Thursday, Jan. 21, at the Fort Shelby hotel, on the subject "Modern Handling Methods in the Foundry." Mr. Hoefman presented interesting data on the economical use of sand handling equipment and mold conveyors.

Talks on Ingot Metals at Pittsburgh

Advantages of use of ingot metal in contrast to virgin metal in foundry practice were discussed by William Romanoff, technical superintendent, H. Kramer Co., Chicago, at the regular monthly meeting of the Pittsburgh Foundrymen's association, held Jan. 18 at the Ft. Pitt hotel. About 45 attended the meeting.

The speaker described the growth of the secondary smelting industry to a peak production in 1929 of 350,000,000 pounds, as well as steps taken a short time ago to provide a more rigid adherence to specifications for various grades of brass ingots. Advantages of cost saving and at the same time comparable tensile strength with that of virgin metal; assurance of accuracy of chemical composition; and rapidity of melting were attributed to ingot metal. Effects of inclusions of iron, aluminum, antimony and other impurities in casting metal also were discussed.

A. M. Ondreyco, foundry metallurgist, Westinghouse Air Brake Co., Wilmerding, Pa., led in the general discussion on the subject following the talk.

Temperature and Iron Affect Bronzes

While bronze, strictly speaking, is a copper-tin alloy, the term now covers a multitude of copper-tin compositions containing a third or even a fourth element. Among the elements that are added, zinc and lead are perhaps the most widely used in bearing bronzes.

A bronze bearing material that has become popular and which has proved its usefulness in service, is the copper-tin-lead alloy. This alloy known as leaded bronze contains a hard copper-tin matrix which surrounds particles of uncombined lead. Many successful bearing materials have a structure consisting of hard particles, embedded in a softer matrix. The softer matrix lends plasticity to permit conforming to small misalignments of the bearing or of the shaft. The presence of lead, which does not alloy with the copper-tin matrix to any appreciable extent, assists materially in reducing the friction, renders the bronze more plastic, and aids in the manufacturing and machining of the alloy.

A study has recently been made at the bureau of standards of the effect of casting temperatures and of additions of iron on the properties of bearing bronze material consisting of 80 per cent copper, 10 per cent tin, and 10 per cent lead. In addition to determinations of hardness and micro-structure of this leaded bronze several methods of tests were employed which simulated certain phases of actual service conditions. These tests included deformation under pounding, resistance to impact or notch toughness, and resistance to wear both dry and in the presence of a coolant. As bearings are usually above room temperature while in operation, a considerable number of the above tests were conducted at elevated temperatures.

In the founding of bronzes it is seldom possible to pour all castings at the same temperature because the metal is drawn from the furnace at various temperatures and cools in the ladle during pouring operations. In the study of 80-10-10 bronze cast at temperatures varying from 1850 to 2120 degrees Fahr., it was found that as the casting temperature, the grain size, and the resistance to wear were increased, the hardness decreased slightly, and a slight tendency was noted for more even lead distribution. Casting the bronze at about 2000 degrees Fahr. caused a decrease in the resistance to impact or lowered the toughness as shown by the notch test. The deformation under pounding was a minimum in specimens cast between 1900 and 2000 degrees Fahr.

Although iron is not usually added intentionally to leaded bronzes, small amounts often accumulate during the process of manufacture through the use of scrapped bearings, iron stirring rods, and so forth. While the iron content is quite small in most cases, the effect of this element generally is considered harmful and in the reported investigation the iron content which varied from 0 to 1.0 per cent was studied to determine its effect upon bearing bronzes. In general, it was found that iron additions over 0.3 per cent were detrimental to the bronze investigated. Small additions of iron (up to 0.5 per cent) decreased the resistance to wear and increased the hardness. When the iron content exceeded 0.3 per cent, segregation of the lead particles occurred, the grain size was reduced, and a decrease was noted in the notch toughness. Additions of iron up to 1.0 per cent increased the resistance to pounding.

Will Unveil the Secret

BEGINNING March 1, 1932, THE FOUNDRY will present two articles on the origin, history and manufacture of titanium aluminum bronze; relating the trials leading to the development of that alloy, and including data on the composition of degasifying alloy, method of manufacture, and other interesting information.

In the early days of aluminum bronze considerable trouble was encountered from worm holes. Many experiments were carried on to obtain a degasifier that would operate as successfully as phosphorus in bronze and brass. Long investigation led to the development of a suitable degasifier for the final metal, which was sold under the name of titanium aluminum bronze. While the degasifying alloy has been available for many years, its composition until now, mainly has been a matter of conjecture.

Charles Vickers, the author of these articles, is well known to readers of THE FOUNDRY as its nonferrous editor, and contributor of numerous articles on nonferrous practice. Mr. Vickers has had 40 years experience as practical molder, foreman, and foundry superintendent, and for a number of years has been a consulting brass foundry expert.

Watch for these articles starting March 1.

Glass Wool Filters Air

The Owens-Illinois Glass Co., Toledo, O., recently has developed a new, self-contained air filter unit in which scientifically treated glass wool serves as the filtering medium. The unit is of simple design and is said to be so low in price as to make feasible the replacement of a complete unit when dirty. The container is of paper, which adds to lightness of the unit. Although the weight of the filter is only 2 pounds, it is designed to absorb dust in excess of its own weight. The paper container provides a tight seal between the filter and the metal frame into which it fits, to prevent the passage of any unfiltered air around the unit.

The filter unit is designed with a 2-inch thickness so that a standard 4-inch pack is provided by using two

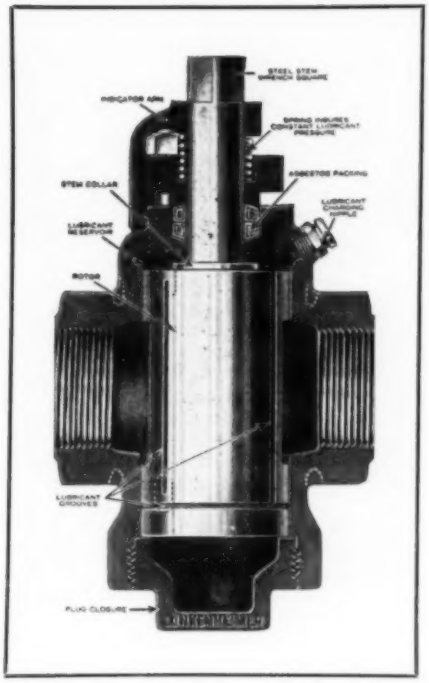
units in tandem, or two units placed face to face. Therefore it is necessary to change only one-half the thickness of the total pack at one time.

Develops Lubricated Rotor Valve

The Lunkenheimer Co., Cincinnati, has developed a lubricated rotor valve which consists essentially of a straight-bored body and cylindrical rotor. The valve is a single-acting or one-way valve made with screw ends for 150-pound flange ends for 125-pound gas or liquid pressure at 150 degrees Fahr.

Lubricant is forced into the reservoir above the closed top of the rotor, the pressure forcing the rotor down as the reservoir fills. The pipe line pressure aided by an external spring, causes the rotor to act as a booster plunger, which forces the lubricant into pockets in the body and grooves in the rotor. From there it is distributed to form a protecting lubricant film for the bearing surfaces, as well as a complete seal when the valve is closed.

When the valve is operated the



The Unit Has a Straight Bored Body and Cylindrical Rotor

sealing groove which passes the port does not contact the lubricant reservoir, and there is no material loss of lubricant. The lubricant is consumed only during opening and closing of the valve, to replenish the sealing film on the bearing surfaces. An indicator attached to the stem serves a three-fold purpose. It acts as a positive open and closed stop, shows whether the valve is open or closed, and indicates the relative amount of lubricant in the reservoir.

Blithely He Starts

(*Concluded from Page* 54)

After 9 years in this position he accepted a similar position with the W. S. Tyler Co., Cleveland and remained there for 12 years, or until he started in business for himself in a modest establishment on the East side. His business expanded rapidly and with the entrance of the United States into the world war, as a manufacturer, reached such proportions that he was induced to build the present extensive plant on the west side of the city.

Why did he change from the east to the west side? Ah, well, who knows? Why does a duck always rise against the wind? Also, why do these birds favor the marshes around Sandusky bay, almost in a bee line—on a good road— west of Cleveland?

What the Foundries Are Doing

Reflecting the Activities of Gray Iron, Malleable, Steel and Brass Shops

Erb-Joyce Foundry Co., Detroit, has moved its Detroit office to 9771 French road.

Beloit Iron Works, Beloit, will build a 2-story addition to its pattern shop at a cost of $40,000.

McConway & Torley Co., Arsenal station, Pittsburgh, has changed its name to McConway & Torley Corp.

Detroit Brass & Malleable Works, Detroit, recently made some improvements in its foundry.

Pratt & Letchworth Co., 189 Tonawanda, Buffalo, N. Y., recently was incorporated with a capital of $3,000,000.

Perseverance Iron Foundry, Latona street and Bassyunk avenue, Philadelphia, will rebuild part of its plant recently damaged by fire.

Franklin Die Casting Corp., subsidiary of the H. H. Franklin Mfg. Co., Syracuse, N. Y., has been sold to the Precision Casting Corp., Fayetteville, N. Y. Purchase price has not been made public.

Metropolitan Square Corp., New York has awarded contracts for vertical aluminum panels for the ten buildings in its development to the Aluminum Co. of America. The buildings will require 22,000 spandrels requiring 3,000,000 pounds of aluminum.

RAW MATERIAL PRICES

Jan. 20, 1932

Iron	
No. 2, foundry, Valley	$15.50 to 16.00
No. 2 Southern, Birmingham	12.00
No. 2 foundry, Chicago	16.50
No. 2 foundry, Buffalo	16.00
Basic, Valley	15.00
Basic, Buffalo	15.50 to 16.00
Malleable, Chicago	16.50
Malleable, Buffalo	16.50
Coke	
Connellsville Beehive coke	$3.25 to 4.50
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	8.00
Scrap	
Heavy melting steel, Valley	$9.50 to 10.00
Heavy melting steel, Pitts.	10.00 to 10.50
Heavy melting steel, Chicago	7.00 to 7.50
Stove plate, Buffalo	8.50 to 8.75
Stove plate, Chicago	6.25 to 6.75
No. 1 cast, New York	6.50 to 7.00
No. 1 cast, Chicago	8.00 to 8.50
No. 1 cast, Philadelphia	10.50 to 11.50
No. 1 cast, Pittsburgh	10.00 to 10.50
No. 1 cast, Birmingham	9.00 to 10.00
Car wheels, iron, Pittsburgh	10.00 to 10.50
Car wheels, iron, Chicago	8.50 to 9.00
Railroad malleable, Chicago	7.00 to 7.50
Agricultural mal., Chicago	7.00 to 7.50
Malleable, Buffalo	9.50 to 10.00
Nonferrous Metals	**Cents per pound**
Casting copper, refinery	7.25
Straits tin	22.30
Aluminum, No. 12, producers	22.00
Aluminum, No. 12 remelt	8.50 to 9.50
Lead, New York	3.75
Antimony, New York	6.00
Nickel, electro	35.00
Zinc, East St. Louis, Ill.	3.00

This is the largest architectural aluminum order ever placed.

The West Point Iron Works, West Point, Ga., has changed its name to The West Point Foundry & Machine Co., and will continue operation under the same management. The shop recently reopened after being idle for several months.

Tulsa Stove & Foundry Co., Tulsa, Okla., whose properties have been sold at bankrupt sale, had been producing oil and gas pipeline equipment. The property has been taken over by interests at Sand Springs, Okla., and no plans have been made for operating the plant.

Army engineer corps has awarded a contract to the Dutton Foundry & Machine Works, Vicksburg, Miss., for 5000 pounds of gray iron castings and 1500 bronze castings. Union Steel Castings Co., Pittsburgh, has received an order for suction pipe castings from the same source.

Crooke, Burnett & Co., York, Pa., comprising a foundry and pattern, machine, plate, structural and welding shops, offering a service for the design and manufacture of special machinery, foundry products, machined parts and the fabrication of plate and structural steel, has been opened by Leonard Crooke and W. J.

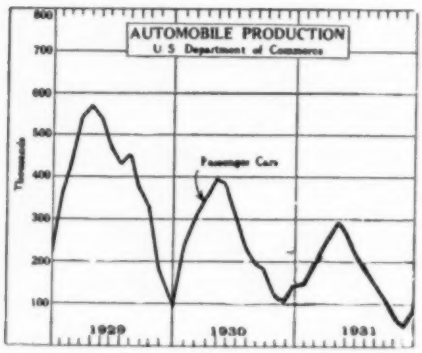
Burnett. Paul G. Koch, 50 Church street, New York, will represent the company in the New York district, and the McGann Mfg. Co., 332 South Michigan avenue, Chicago, will be representative in the Chicago district.

Fairmont Foundry & Mfg. Co., Fairmont, W. Va., has been incorporated by Lewis J. Carskaden, Watson building.

Equipment and patterns of the Three Rivers, Mich., foundry of the Fairbanks-Morse Co. have been moved to the main plant at Beloit, Wis.

Waterloo Foundry Co., Waterloo, Iowa, recently moved into a new plant at 1049 Sheffield avenue. A. J. Fischels is owner of the foundry.

Loss estimated at $7250 resulted from a fire in the pattern shop of the Nordberg Mfg. Co., 3073 South Chase street, Milwaukee, on Dec. 30.



Standard Foundry Co., Racine, Wis., makers of gas engine cylinder castings from electric furnace iron, completed a busy and profitable year in 1931. Arthur Janes is president of the company.

Rufus Lowrance, 1125 West 11th street, Pueblo, Colo., is reported planning a foundry at a west Fourth street location. The city zoning board recently approved the location.

Vernon Pattern Works Inc., Huntington Park, Calif., recently was organized to acquire a company under the same name at 2020 Laura street. Edward Fesserschmidt and A. J. are in charge of the new company.

Monroe Steel Castings Co., Monroe, Mich., is reported to have enjoyed a steady and healthy demand for their product during 1931. Carl F. Clarke is president, Paul Geigenmueller treasurer and Louis Bassini superintendent.

Officers of the Waterbury Foundry Co., Waterbury, Conn., manufacturer of sash weights and gray iron castings, are as follows: A. A. Tanner, president; J. S. Neagle, vice president; J. L. Kipp, treasurer; A. E. B. Tanner, secretary.

Foundry schedules in the Chicago district at mid-January had made little improvement over the early part of the month, operations being about 18 to 20 per cent. Automotive foundries in western Michigan were the only ones to maintain earlier gains.

Studebaker Corp., South Bend., Ind., recently installed a complete new molding unit, consisting of molding machines, sand handling system, etc., for the manufacture of 500 Rockne cylinders a day. An interesting gas fired forced draft mold dryer is incorporated. R. J. McSherry is foundry manager.

Headford Brothers & Hitchens Foundry Co., Waterloo, Iowa, recently closed its forty-first year of successful operation. The plant was established in 1890 at Dubuque by E. H. Headford and W. T. Headford and two years later F. O. Hitchins joined the organization. Twenty-eight years ago the company moved to Waterloo, where it specializes in gray iron castings. During the past year, Owen S. Hitchins succeeded his father, the late Frank O. Hitchins, as vice president of the company.

Foundry operations in the Pittsburgh district recovered slightly in January from the low level established during the holiday period when most plants were closed. Average schedules remain below 20 per cent, however, with seasonal stimulus to operations still awaited. Production by heavy machinery builders is lighter following relatively good activity during 1931, while output of mill rolls and ingot molds is quiet and little changed. Schedules of radiator and sanitary ware producers lack improvement.

The new gray iron fittings foundry of the Detroit Brass & Malleable Works, Wyandotte, Mich., recently has been put into full time operation. Machinery of modern design has been used throughout, from the initial handling of raw materials by a charging machine to continuous tumbling and cleaning mills. Investment in the plant and equipment is reported to approximate $250,000. F. L. Uhl is president of the company. Leonard E. Hurst, formerly of Miller-Hurst and for many years with the Ford Motor Co., is credited with design and erection supervision.

Doehler Die Casting Co., New York, has purchased from the National Lead Co. all equipment, inventories and goodwill of the Newton Die Casting Corp., New Haven, Conn. As a result of the transaction, the National Lead Co. becomes a substantial stockholder in the Doehler company. National Lead will be represented on the Doehler board of directors. Most of the equipment of the Newton company will be moved to Doehler's plant at Pottstown, Pa. A short time ago, Doehler acquired the die casting division of the Bohn Aluminum & Brass Corp.

Trade Publications

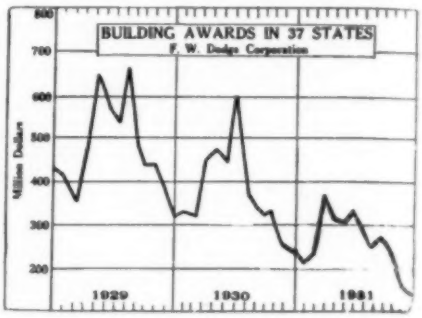
Pumps—American Manganese Steel Co., Chicago Heights, Ill., has issued a four-page section for its catalog on its type C materials handling pumps. The publication is illustrated and contains data sheets for direct-connected and belt-driven pumps.

X-RAY TESTING—Combustion Engineering Corp., 200 Madison avenue, New York, has issued a pamphlet on the X-ray method of testing, as prescribed in the A. S. M. E. code. An installation of X-ray equipment representing the latest development is described.

ELECTRICAL EQUIPMENT—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., in a leaflet describes its single-phase motors, showing applications on pumps, compressors, ventilating fans, blowers, farm machinery and other uses where high starting and high accelerating torques are necessary. Another leaflet describes group-type capacitators for power factor corrections on 60-cycle circuits.

TRAMRAIL—Cleveland Electric Tramrail division of the Cleveland Crane & Engineering Co., Wickliffe, O., has issued a bulletin calling attention to possibilities of adapting its equipment to the careful moving of unwieldy and unusual loads in various branches of industry.

MULTI-SPEED DRIVE—A recent bulletin by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., describes an adjustable speed reducer built into a standard induction motor, in standard sizes from ½ to 15 horsepower. Change of speed is made with the motor running under load. Infor-



mation is given on application, operation and construction of this drive, with table of output speeds and principal dimensions.

WELDING AND CUTTING EQUIPMENT—Bastian-Blessing Co., 240 East Ontario street, Chicago, has published a new catalog No. 57 which lists specifications of all types of welding and cutting torches, regulators, gas economizers, acetylene generators and other accessories made by the company. Each piece of equipment is described in detail and the various uses are listed.

ELECTRIC FURNACES—Ajax Electrothermic Corp., division of the Ajax Metal Co., Ajax Park, Trenton, N. J., has issued its technical bulletin No. 7 on oscillator or spark-gap type converters and furnaces. The text includes general information on the principle employed in the construction of the furnaces, the advantages claimed and the field of use. Detailed technical information on each type of furnace is presented in text, illustration and drawings and a discussion of refractories and methods of lining also is presented. The bulletin is well illustrated.

PUMPS—Worthington Pump & Machinery Corp., Harrison, N. J., has released a number of bulletins and catalogs devoted to its products, as follows: L-621-B3, air compressors, vertical and horizontal; W-312-S2A, centrifugal pumps, single-stage volute; W-312-S3A, centrifugal pumps, single-stage, volute; W-312-S9, centrifugal pumps, single-stage, volute; W-218-S3A, centrifugal pumps, two-stage, volute; D-112-B3, horizontal steam pumps for oil process; D-412-S5, power pumps, horizontal duplex; D-423-E10, power pumps, vertical triplex, single-acting; L-400-B1A, Multi-V-drive; D-450-B4, deep well pumps; WD-310-B3, centrifugal pumps, groups; DW-110-B1, steam pumps, self-acting, simplex and duplex; D-412-B1, power pumps, horizontal and vertical.